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DEVELOPMENT OF TITANIUM AND STEEL FATIGUE VARIABILITY MODEL FOR APPLICATION OF RELIABILITY ANALYSIS APPROACH TO AIRCRAFT STRUCTURES

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THE BOEING COMPANY

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FOREWORD

The research work reported herein was conducted by The Boeing Company for the Metals and Ceramics Division, Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, under contract F33615-71-C-1134. This contract was initiated under project 7351, "Metallic Materials," task 735106, "Behavior of Metals," with Mr. R. C. Donat acting as project engineer.

The study was conducted at The Boeing Company, Commercial Airplane Group, Structures Technology Staff, Fatigue Research Group, in Renton, Washington, under the direction of Mr. J. P. Butler as program manager. The period covered by this effort is November 16, 1970 through March 15, 1972, and the report was completed in May 1972.

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This technical report has been reviewed and is approved.

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ABSTRACT

An investigation of the fatigue performance test scatter in titanium alloys and steels has been made with the intent of identifying their variability in terms of a distribution and its shape parameter. The two-parameter Weibull distribution was selected for matching the fatigue variability of these two materials. About 1200 groups of titanium alloy and 800 groups of steels were collected and analyzed to determine the feasibility of establishing a typical distributional Weibull shape parameter for these materials. A Weibull distribution shape parameter of 3.0 is suggested for titanium alloys and those steels with a 240-ksi strength level or less. Steels having greater than a 240-ksi strength level seem better represented by a shape parameter of 2.2. In a further study, the choice of a distribution most aptly matching fatigue variability was explored with the use of previously collected extensive aluminum alloy and the titanium alloy data. The behavior of these data was compared to that of equivalent log--normal, two-parameter, three-parameter, or a devised "symmetric" Weibull distribution. Monte-Carlo simulation was used to form empiric distributions from parent analytical populations. These distributions were then compared to the distributions of the collected fatigue test data, keeping the simulated data group sizes and number of groups the same as those for the test data. No appreciable difference between data and the selected equivalent theoretical distributions is evident for probabilities of failure in the range of 0.05 to 0.95. For a failure likelihood less than 0.05 the Weibull distribution seems more representative of the data extremes.

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ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

E	mathematical expectation
exp	exponential function
ln	natural logarithm
log	common logarithm
P( )	probability of that event described within parentheses

SYMBOLS

n	number of identical specimens or details in fatigue test group
s	experimental data sample standard deviation
t	cyclic fatigue life of a test specimen or detail
x_i	$\log_{10}$ cyclic life of a fatigue-tested detail
$\bar{x}$	$\log_{10}$ mean cyclic life
y_i	same deviation statistic, $\sqrt{n/(n-1)}\ (x_i - \bar{x})$
$\bar{y}$	mean of sample deviation statistic
α	Weibull distribution shape or scatter-controlling parameter
β	Weibull distribution scale parameter or characteristic life to crack initiation
μ	mean of normal distribution of x_i
σ	shape parameter of the normal distribution of x_i, i.e., the standard deviation
σ^2	variance of normal distribution of x_i

SECTION I

INTRODUCTION

Premature or unexpected initiation of fatigue damage in the structural system of an airplane fleet can be a serious detriment to the operational use and availability of that fleet. To minimize the influence of this variability in structural fatigue performance, a scatter factor is generally applied to nominal, representative, mean, or median data to ensure or obtain a reliable estimate of some level of minimal fatigue performance. Hopefully, a goal of even no fatigue damage initiation may be contemplated in the process of applying the scatter factor.

Judgment and/or probabilistic considerations have generally guided the selection or development of these scatter factors. The application of reliability analysis techniques to placing lower bounds on the initiation of fatigue damage requires the definition of the distributional characteristics of fatigue scatter in materials and their structures. The log-normal and Weibull distributions have been used in the past to resolve these probabilistic features of reliability analysis. Actually, the central characteristics of fatigue variability can be reasonably identified with a few fatigue test specimens at some level of confidence by presuming the identification of the distribution and its shape parameter. However, fatigue testing in itself is complicated and expensive in time and dollars. Hence, the positive identification of the distribution, that truly identifies fatigue variability over the entire range of scatter likely to occur in a material, becomes a formidable or impossible task under the usual circumstances of the design phase. Furthermore, the initial appearance of fatigue damage in a fleet of aircraft triggers unanticipated action including a fleet-wide special inspection, continued fleet surveillance, repair, or rework that may even penetrate back to the production line in certain circumstances until the difficulty is resolved.

In an approach to the application of reliability analysis procedures to fatigue performance assessment, reference 1 introduces the concept of order statistic or "first" failure in a fleet or group of parts. Instead of design evaluation to merely a probable level of fatigue performance at a selected confidence level, a reliability goal is suggested to identify the occurrence likelihood of the first, or immediately successive, fatigue crack initiation in the fleet of aircraft. Application of this procedure really needs identification of the distributional characteristics of fatigue performance over both the central and the extremely remote lower limits of fatigue behavior. By examining large quantities of available fatigue test data and accounting for sampling errors (i.e., limited numbers of identical specimens identically tested) some guidance may be obtainable in the selection of both the basic distribution and its shape parameter to represent fatigue variability. The variability in aluminum alloy was studied in reference 1, while this work presents the results of a review of the variability in titanium alloys and steels and an investigation to determine the likely distribution and its shape parameter.

SECTION II

EVALUATION OF SCATTER IN TITANIUM ALLOY AND STEEL FATIGUE DATA

Fatigue variability in structural titanium alloys and steels, as demonstrated by existing test data, was examined in this study with the intent of identifying a representative distribution and its likely shape parameter for application to the reliability analysis system developed in reference 1. The scope of this investigation has been limited to a fairly thorough, though not exhaustive, survey of the available literature.

Approximately 40 references on titanium and a similar number on high-strength steel were found to contain suitable data. These data amount to approximately 1200 groups of titanium and 800 groups of steel results. The selection of the data has followed the guidelines outlined in reference 1 in that information was limited to those test data which had similarity with aircraft structural applications. Consequently, results from the considerable amount of information on unnotched specimens or rotating beam tests have *not* been included in the studies.

These selected data, which have been summarized in appendix II of this report, were subjected to statistical analysis using the "first-two-ordered-failures estimator" described in reference 1. This estimator, which is both simple and speedy, was used because of the large amount of data for analysis. The task involved the computation of a shape parameter for each of the hundreds of data groups investigated, the determination of the cumulative frequency distribution of the shape parameters, and the calculation of the weighted mean value of the shape parameter of each set of pooled data. The weighted mean value was used to take into account the variation in sample sizes within each pooled data set. Reference 1 has shown that this estimator, when used to analyze a mass of data to obtain a central-tendency value of their shape parameter, is capable of giving an answer which is quite comparable with that obtained by using a "maximum likelihood estimator." The results of the statistical analysis are presented in figures 1 through 14 and tables I through V.

The initial discussion will be limited to the titanium results. As mentioned earlier, approximately 1200 selected groups of data were collected and analyzed. The reporting period for these data ranged from August 1958 to July 1969 and is believed to be fairly representative of current titanium structural applications. The data were limited to the two common alloys of Ti-6Al-4V and Ti-8Al-1Mo-1V in the mill-annealed, duplex-annealed, solution-treated-and-aged, and solution-treated-and-overaged conditions for the former and the mill-annealed, duplex-annealed, and triplex-annealed conditions for the latter. For the initial analyses, no distinction was made for the various conditions but all data simply pooled according to alloy type. Figure 1 illustrates the similarity in the scatter of the two alloys by comparing the cumulative frequency of the shape parameter estimates from 541 groups of Ti-6Al-4V against that obtained from 586 groups of Ti-8Al-1Mo-1V. It is noted that the Ti-6Al-4V alloy tends toward slightly larger scatter, as the distribution curve lies consistently to the right of the Ti-8Al-1Mo-1V curve. The result, as shown, is that the weighted mean value of shape parameter of the Ti-6Al-4V data is slightly larger than the weighted mean value for Ti-8Al-1Mo-1V.

These two groups of data were then pooled, so that material alloy distinction was lost before subdividing into the specimen-type groups identified in figure 2. It can be seen that the variation between the results from 637 groups of monolithic notched data and 488 groups of simple structural simulator specimens is marginal, with the notched data having slightly lower scatter at the low percentiles but also fractionally more scatter at the higher percentiles. The net result is that the weighted means of both groups are virtually identical.

A test was next conducted to determine the effect of fatigue testing at room temperature, at elevated temperature, or at lowered temperature. However, insufficient data of the latter category were analyzed, so the results plotted in figure 3 compare only room temperature and elevated temperature fatigue data. This study demonstrates that both data groups are comparable, except for the higher percentiles where the elevated temperature curve falls away, indicating slightly higher scatter. This fall-off is reflected in the higher weighted mean shape parameter of the elevated temperature data. It should be noted that the 825 groups of room temperature results contain almost three times the information contained by the 279 groups of elevated temperature data and conceivably could account for the variation noted.

The next test studied range of cyclic life as the parameter, and the results are shown plotted in figure 4. The constant-amplitude fatigue test data were subdivided into five groups based on cyclic life. Four of these groups are identified in figure 4. The fifth group, which contained low-life data (i.e., $<10^3$ cycles), did not contain sufficient data to arrive at a meaningful result and so was not plotted. An undesirable trend is evident from this figure, namely that scatter increased with increasing life. This trend, which has been frequently reported in the literature, was not observed in the study on aluminum, see figure 5, which shows scatter as fairly constant regardless of life range. Returning to the titanium results, it is noted that curves (a) to (c), although different from each other, are closer together than curve (d), which shows very large scatter. Therefore, it was decided to delete the data contained in this group from the total data sample, to negate the influence of this higher life, large-scatter sample.

Table I compares the weighted mean shape parameter values resulting from the series of tests mentioned previously. The column of results on the left is based on the total analyzed data, whereas the column on the right excludes the 111 groups of data which contained fatigue results with cyclic lives exceeding $4 \cdot (10)^5$ cycles of constant-amplitude loading. As expected, the right column shows lower values of scatter. Figure 6 compares the results from all the data against the results when data were restricted to less than $4 \cdot (10)^5$ cycles. It is obvious that the latter case has the lower scatter. It was also noted from the table I results that the individual values of the mean shape parameters were closer together for the restricted data. The comparison of room temperature and elevated temperature results, figure 3, had shown the most discrepancy. Consequently, this same comparison was made, using the restricted data sample, and plotted on figure 7. Comparing figure 3 with figure 7 shows that in the latter case the two plotted curves are closer together, that they have both shifted to the left, and that the difference in the weighted means is reduced.

During extraction and summarization of the titanium data it was observed that data reference 232 (see appendix II) contained constant-amplitude fatigue test results for different

stages of fatigue damage. It was decided to give this reference a closer scrutiny and to analyze the results separately. Four items of information were obtainable from the tabulated results. These were:

- Number of cycles to initial, minute crack
- Number of cycles to repropagation of the crack of predetermined size, when the test was recontinued at a lowered maximum stress level
- Number of cycles to total failure
- Increment of cycles between start of crack repropagation and specimen failure

Weibull shape parameter distributions for these four conditions are plotted in figure 8 as curves (a), (b), (c), and (d), respectively. The data for curve (a), scatter to initial crack, were grouped according to the test load and crack length. Within these groups, individual crack lengths differed by less than 0.001 in. The data for curve (b) were considered as an independent set representing "initial failure" of a specimen with a fatigue crack. It should be noted that the data for curves (b) to (d) were grouped according to test load level and nominal crack length, and differences in initial crack length up to 0.02 in. were observed. As the sampling of data was so small, no attempt was made to determine a mean value of shape parameter, and figure 8 is presented simply to illustrate the trend of the data. It can be seen that the scatter in times to initial cracking of the uncracked specimens, curve (a), is considerably lower than the scatter in times to crack repropagation of the specimens containing small fatigue cracks, curve (b). However, scatter in times to failure of these precracked specimens, curve (c), is quite similar to that for initial cracking of the uncracked specimens. This "coming-together" of these scatter curves when scatter at the intermediate stage was so large could be explained if the scatter of the increments of life during crack propagation to failure was lower than the scatter in lives to initial cracking. Curve (d) shows this to be exactly the case. It would appear from this survey that scatter during separate phases of fatigue life can be quite different, but at the same time these phases are not independent of each other.

A somewhat smaller amount of data has been analyzed on high-strength steel, in current use, than for the titanium investigation, but nevertheless certain similar trends have become apparent. The results obtained have been plotted on figures 9 through 14 to provide illustration of these trends, and the weighted mean shape parameters are tabulated in tables II to V for reference.

Figure 9 compares three common categories of high-strength alloys. It should be noted that the plotted curves do not have the same degree of confidence, as they were generated from quite different amounts of data. For example, the austenitic stainless steel curve was based on estimates from 48 groups, whereas the stainless steel curve was obtained from 314 data groups. However, the plots are presented to demonstrate the trend of alloy variability. Moreover, if the study had been limited to those categories containing at least 100 groups of data the trend would be unaltered, as the alloy and stainless steels show similar levels of scatter but the 18% nickel maraging steel demonstrates a larger amount of scatter. The grouping of the curves indicates several levels of scatter, the lowest coming from the austenitic stainless steels and the highest from the nickel maraging steels. The remaining alloys investigated, such

as alloy steel, intermediate alloy steel, stainless steel, and superalloys were noted to fall between these two extremes, see table II.

It was noted in figure 9 that the alloys which tended toward the lower strength level had a tendency toward lower scatter, and those of a higher strength level toward higher scatter. It was therefore decided to conduct a test based on strength level only, in which the identity of the alloy was unimportant. Figure 10 plots the results of this test, and it is immediately apparent that the earlier conjecture was indeed correct and that scatter increases with increasing strength level. Again, as in the preceding figure, the extremes and an intermediate distribution of scatter have been plotted for illustration, the lowest for steels below 160-ksi ultimate strength and the highest for steels above 280-ksi ultimate strength. It should be noted that the curve showing least scatter had the smallest sample size and consequently appears rather erratic. However, it is believed that the trend of the curve is reliable and can be compared with the other plotted curves and the values given in table II.

Figure 11 looks at scatter as a function of cyclic life under constant-amplitude testing. The resultant trend shows that scatter increases with increasing cyclic life. This is the same conclusion reached in the titanium study described earlier, and, as mentioned before, is in contradiction with the aluminum results.

Variations of the shape parameters with type of steel, strength range, and cyclic life are presented in tables III through V. Table III shows typical shape parameters for high-strength steels varying with three strength ranges. It can be seen that there are no definite trends for the variations in scatter with the type of steel within these strength ranges.

Table IV compares the typical shape parameters for stainless steels varying with strength and life. The trend shows that scatter increases with increasing cyclic life, as was shown for the total group of steels in figure 11 and table II. A similar trend for increasing scatter is also shown for the two strength ranges indicated.

Table V shows the breakdown of scatter with cyclic life for steels with strengths below and above 240 ksi. It is shown that cyclic life is definitely a parameter in both strength ranges. However, there appear to be appreciable differences between the shape parameters for the same life range, excluding lives $>4\cdot(10)^5$ cycles, in these strength ranges. These observed trends should be investigated further.

Figure 12 illustrates the comparison between the monolithic notched data and those of simple joints. The latter curve contains approximately half the data of the former but nevertheless shows a similarity to it. The weighted mean values given in table II also show agreement, and it can be concluded that this is not a parameter that needs much consideration.

During analysis of the steel data, it was observed that data from reference 303 contributed excessively to the shape parameter for the elevated temperature data. Figure 13 shows the effect of the 15 groups of data in reference 303 on the cumulative frequency distributions of all elevated temperature data (130 groups). Because of this large increase in scatter contributed by such a small group of data (i.e., $\approx 9\%$ of total), reference 303 is currently omitted from the existing steel fatigue data bank.

Figure 14 also compares the room temperature results against those given by elevated temperature data. It can be seen that there is a disparity in sample size, with the room temperature data sample considerably larger. However, the two distributions plotted are fairly similar, as are their weighted means, and therefore this would not appear to be a major parameter for further consideration.

The conclusion to be drawn from the preceding discussion is that the investigation has revealed a few uncomfortable, although not entirely unexpected, problems. Scatter was observed to be influenced by cyclic life for both titanium alloys and steels. The latter material also tended to vary with type of steel and/or strength range. However, a central tendency value for the shape parameter for titanium would appear to be $\alpha = 3.0$, with the exception of the long-life, constant-amplitude data, i.e., lives $>4 \cdot (10)^5$ cycles. Most current structural components, when subjected to some equivalent constant-amplitude cycle such as a ground-air-ground cycle, perform below this level of life. Details such as turbine blades, rotor blades, etc., are obviously not included. It is suggested, therefore, that a shape parameter of $\alpha = 3.0$ will cover most titanium applications.

Steels apparently need to be treated in a different manner. It has been shown that the shape parameter is influenced by both strength level and life length. Therefore, no unique value such as that suggested above for titanium or in reference 1 for aluminum can be justified. However, again limiting the application to lives below $4 \cdot (10)^5$ cycles, it might be sufficient to assume a minimum of two shape parameters, see table II, as follows:

$\alpha = 3.0$ for steels with ultimate strength ≤ 240 ksi

$\alpha = 2.2$ for steels with ultimate strength >240 ksi

SECTION III

EVALUATION OF DISTRIBUTION MODELS FOR FATIGUE VARIABILITY

Another item of investigation has been directed toward the further definition of the distribution model for representing structural fatigue performance variability. Because of the lack of large samples of data suitable for definition of the basic fatigue variability distribution, and the associated initial appearance of fatigue damage in a large number of details, as may be found in a fleet of aircraft, attention is focused on the possible use of many groups of data with only a very small number of details in each group. The tacit assumption is made that all groups of qualified data, especially full-scale structures, represent random selections from some general distribution which has a unique shape parameter (reference 1). The scale or location parameter varies from group to group. No single group of available fatigue data is large enough to indicate the "Right" or "Wrong" distribution over a wide range. Therefore, the hundreds of groups of collected, sorted, and qualified data must be combined in some way that will be independent of the scale parameters. To account for sampling errors, the behavior of the actual data must be compared with the behavior of an equal mass of data generated from the candidate distribution functions. One way to accomplish this in general applications is by resorting to Monte-Carlo simulation techniques.

The specific approach used for this study was based on the sample statistic:

$$y_i = \sqrt{n/(n-1)}\,(x_i - \bar{x})$$

where n = complete, uncensored sample size (i.e., no censored samples acceptable).

$x_i = \log_{10} t_i$, with $t_i = i^{th}$ fatigue life

$\bar{x} = (1/n)\,\Sigma x_i$

This statistic y is the specimen deviation and has been adopted because it possesses several desirable properties. These are:

- It is fairly simple
- It has scalar invariance
- It has similar shape parameter as x
- When x is normal with parameters (μ and σ) then y is normal with parameters (zero and σ).
- If x has variance σ^2, then y has variance σ^2.

This is proved in appendix I.

The calculation of the statistic, y_i, and the development of the cumulative frequency distribution of that statistic, was computerized to minimize the manual work. To judge the fit of the test data to a specific type of theoretical distribution, a Monte-Carlo simulation technique generated equivalent "empiric" cumulative distributions from populations of the matched theoretical distribution. In order that these generated curves should represent similar levels of sampling error as those contained in the fatigue data, they comprise groups of observations of identical size and number as those contained in the real data. For example, if the fatigue data contained 500 groups of two specimens each, 400 groups of three specimens each, and 200 groups of four specimens each, giving a total of 1100 groups and 3000 specimens, then similar samplings comprising 3000 random observations would be taken from the defined distribution to generate the "empiric" curve. Breakdowns of the group sizes of the actual fatigue data studied are given in tables VI and VII.

The initial attempt at this procedure was made using the aluminum full-scale structural data of reference 1. These comprised 392 uncensored groups containing 1140 specimens ranging from large structural panels to complete structures. These specimens were subjected to testing procedures varying between simple constant-amplitude and complex variable-amplitude test loading. The heavy line in figures 15 and 16 represents the cumulative distribution of the 1140 calculated specimen deviations (y_i values). Emphasis is focused on the lower half of the distribution. The two-parameter log-normal and Weibull distributions were used to generate the empiric distributions shown superimposed on the data curves in figures 15 and 16, respectively. In order to randomly sample a theoretical distribution which was equivalent to the fatigue data distribution, the parameters defining both statistical models were established from the test data results. The average of 10 separate runs through the sampling process, i.e., 10 separate sampling distributions from a log-normal population, is shown in figure 15. The dotted lines represent the upper and lower limits resulting from the 10 samplings. It can be seen that below the fifth percentile, the data and empiric curves diverge with the latter becoming more and more unconservative. For comparison, figure 16 shows the results of a similar sampling from a Weibull population. This shows a much better agreement at the lower extremities, and the data curve is seen to be encompassed by the upper limit of the 10 samplings. At probabilities above the 5% level, both the log-normal and Weibull models perform adequately, although it is noted that the latter remains in fractionally closer proximity with the data curve.

The next study was limited to the collected and qualified aluminum variable-amplitude data. Only those data noted to have scatter similar to that found under structural applications were used. These comprised test results ranging from simple notched specimens to complete structures subjected to either axial or flexural loading. A total of 210 uncensored groups containing 1023 specimens were used to define the solid data curve shown in figures 17 and 18. The same procedures described in the preceding paragraph were used to generate the empiric log-normal and Weibull curves shown superimposed on the data in figures 17 and 18, respectively. It can be seen that the same trends noted previously for structural data are repeated in the case of the variable-amplitude data.

The mass of aluminum fatigue data qualified as acceptable (reference 1) and comprising 1374 uncensored groups containing 4952 fatigue test results have been analyzed and are shown plotted in figures 19 and 20. Superimposed are the generated empiric log-normal and Weibull curves. It should be noted that the 10 samplings used to obtain these curves represent

almost 50,000 random observations from each distribution model. Once again, the improved data fit obtained from the Weibull population is obvious, being noticeably better than the log-normal curve at the lower tail and marginally better at the higher percentiles.

The preceding plots of fatigue test data distributions consistently display a hooking characteristic at the extremities. Consequently, some effort was expended on determining the nature of the test data comprising these tails. The test groups which contained fatigue observations at the tails had to be identified and studied for some indication of a consistent trend in the wide scatter exhibited by these data. Approximately 12% of the total collected data groups contained observations forming the distribution tails, of which about 7% reflect simply larger than average scatter, while the other 5% were split almost equally between data containing either low-time or high-time outliers. These higher scatter data groups were also noted to be independent of material type, specimen configuration, or method of testing and were obtained from a variety of sources. Because there was no apparent systematic idiosyncrasy reflected in these data, it was decided that one further test be conducted.

The distribution of results from the full-scale aluminum alloy structural data has been replotted in figure 21. A total of 18 of the 392 groups represented in the data curve were found to contain observations that might be termed as either high-time or low-time outliers. It could be argued that these data may represent samples from different populations and as such might be biasing the investigation results. These 18 data groups were consequently deleted and the remaining 374 groups reanalyzed using the same statistic described earlier. Figure 22 shows the distribution of results obtained after deletion of the outlier groups. The equivalent distributions generated by sampling from a two-parameter Weibull and a log-normal population are compared with the data results. Comparing figures 21 and 22 it can be seen that with the omission of the 18 suspect groups the Weibull model becomes an even better representation of the data distribution, but the log-normal model still remains unconservative. It is also interesting to note that the deletion of these few data groups ($\approx$5% of the sample) resulted in a lowering of the sample standard deviation, s, from the original value of 0.172 to a new value of 0.148.

Note that:

$$s \approx (\sqrt{\bar{n}/(\bar{n} - 1)})\ \sigma \quad \text{where } \bar{n} = \text{average number of specimens per group of m groups.}$$

It can be concluded, therefore, that this further study has substantiated the earlier results in reference 1 for aluminum alloy.

The preceding results have all demonstrated the poor correlation at the extreme tail between the distribution of fatigue data and the distribution predicted by the log-normal model. The correlation with a two-parameter Weibull distribution was notably better. These observed trends can be further substantiated by available test data. Figure 23 is a copy of figure 19, except that the lower tail of the data distribution has been isolated. Curve A is the log-normal estimate based on all the fatigue data, see figure 19, but curve B could be the expected prediction if only the data within the heavily outlined box were considered. The

ratio of the slopes of these two curves is approximately 2:1. In other words, the shape parameter based on the data extremes only will be approximately twice the expected value. Consider now the test results of reference 2, where both central tendency and extreme fatigue data were generated. With the assumption of a log-normal distribution the following ratios of shape parameters were obtained (table VIII):

$$\frac{\text{Shape parameter for data extremes}}{\text{Shape parameter for central tendency data}} = \frac{0.098}{0.051}\ (\text{case 1});\ \frac{0.181}{0.082}\ (\text{case 2})$$

It is obvious from these results that the expected trend described in figure 23 is indeed the case, and that the log-normal model is sensitive to the statistical nature of the test data. Furthermore, this overestimate of the shape parameter (extreme data) results in estimates of the scale parameter which are also too high, see table VIII. It should be noted that because of specimen size and machine availability the data extremes were generated at approximately 300 cpm, whereas the central tendency data were obtained at 1800 cpm. Consequently, from data in reference 3 it was expected that:

Scale parameter for data extremes $\leqslant$ scale parameter for central tendency data

Consider now the results obtained with the assumption of a two-parameter Weibull distribution. From figure 20 it can be seen that this model is capable of a fair representation of the fatigue data, and therefore should not be unduly affected by the statistical location of a data sample. Once again, this trend is substantiated by the test results of reference 2 summarized in table VIII. The shape parameter estimates of extreme and central tendency data are within 7-1/2% of each other at worst; also, the predicted scale parameters of the extreme data tests are slightly below the central tendency results and so conform with the frequency trends established in reference 3.

Figure 24 shows once again the distribution of the 4952 test data. Superimposed are the averages of 10 Monte-Carlo simulations from equivalent log-normal, two-parameter Weibull, and three-parameter Weibull distributions. The minimum life term of the three-parameter Weibull was arbitrarily selected at approximately 10% of the characteristic life for this study. Note the generally similar behavior of all three distributions at the high percentiles and the general divergence from the fatigue data. It is also noted that the fatigue data follow a somewhat symmetrical S shape, which the two-parameter Weibull fits fairly well except at the upper tail. Therefore, the possibility of modifying the Weibull distribution to reflect the symmetry of the fatigue data was considered. A first attempt at this was done by accepting the lower 50% of the Weibull distribution and replacing the upper 50% by the mirror image of the lower half.

The cumulative frequency function of this distribution is defined in terms of the median time to failure, as follows:

$$F(x) = 2^{-(x/M)} = e^{-\ln 2(x/M)} \text{ when } x < M$$

and

$$F(x) = 1 - 2^{-(M/x)} = 1 - e^{-1n2(M/x)} \text{ when } x > M$$

This failure model is noted to be one of a class of distributions in which the logarithms of the observations have distributions which are symmetric about zero. Some initial work on this distribution model will be reported in reference 4.

Figure 25 shows the distribution of the 4952 qualified aluminum fatigue test data. Superimposed are the results of 10 Monte-Carlo simulations from an equivalent "symmetric-Weibull" population. It can be seen that the shape of the "empiric" curve is approaching that of the fatigue data but is insufficiently skewed to overlap the data. Some additional work will be necessary to determine the feasibility of incorporating a rotation parameter in this distribution model.

Finally, figures 26 and 27 describe the distribution obtained from 983 groups of collected and qualified titanium fatigue data. These groups contained a total of 2715 test specimens and were grouped as shown in table VII. The superimposed empiric curves show the same trends observed with the aluminum data, namely, the improved fit obtained from the sampling of an equivalent two-parameter Weibull population over that obtained from an equivalent log-normal population.

SECTION IV

CONCLUSIONS

A statistical study of the scatter in titanium alloy and steel fatigue test data has been made to guide the selection of a distribution and its shape parameter for application to a fatigue reliability analysis approach. The merit of the particular distributional models was judged by the comparison of cumulative frequency distributions of the test data and the range of 10 similar-sized empirical distributions selected by Monte-Carlo techniques from the analytical distribution function population matched to the data.

The study on the scatter in titanium and high-strength steel fatigue performance data was limited to:

- Current, structurally applicable alloys
- The notched configurations, including monolithic notched and simple structural simulators such as lap and butt joints
- Axially loaded or flexurally loaded tests
- Constant-amplitude or variable-amplitude tests

1. The results of the investigation have demonstrated that the estimated mean shape parameters are sensitive to:
   - Range of cyclic test life—both titanium and steel show that scatter increases with increasing test life
   - Range of strength—the steel data show an increase in scatter as the material's strength increases
   - Type of steel
2. The results of the investigation have also demonstrated that the estimated mean shape parameters are relatively insensitive to:
   - Type of specimen, whether simply notched or a structural simulator
   - Test temperature, whether at room or elevated temperatures
3. Average values of the Weibull shape parameter have been tentatively suggested as:
   - α = 3.0 for titanium applications

- α = 3.0 for steel which has an ultimate strength $\leq$ 240 ksi
- α = 2.2 for steel which has an ultimate strength $>$ 240 ksi

but should be treated with a degree of caution because of the interdependence of scatter with cyclic life.

4. Both the log-normal and the two-parameter Weibull distributions are capable of describing the fatigue data between the fifth and 95th percentiles.

5. In the important region of the early failure, i.e., below the fifth percentile, the log-normal model produces an optimistic assessment of the fatigue data distribution.

6. The two-parameter Weibull model is capable of an acceptable representation of the fatigue performance data distribution below the fifth percentile.

7. Above the 95th percentile, the log-normal, the two-parameter, and the three-parameter Weibull distribution all produce conservative assessments of the fatigue data.

8. A modification to the Weibull distribution, introducing a mirror image about the median time to failure, gives promise of being able to describe fatigue data over the complete range.

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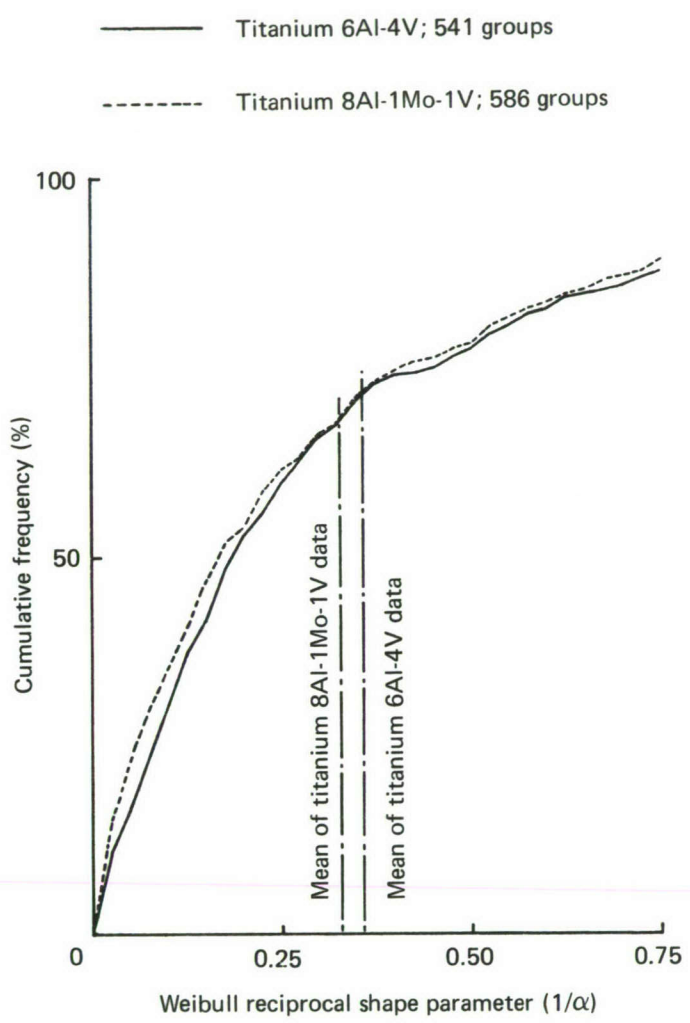

Figure 1. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Two Major Titanium Alloys

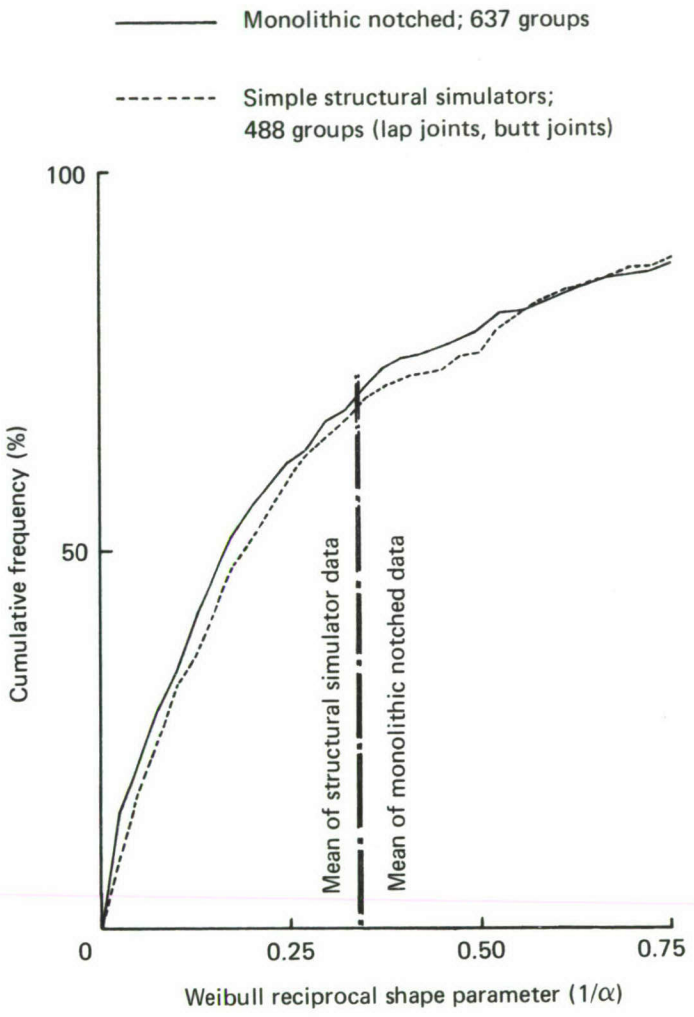

Figure 2. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Different Test Specimen Types—Titanium

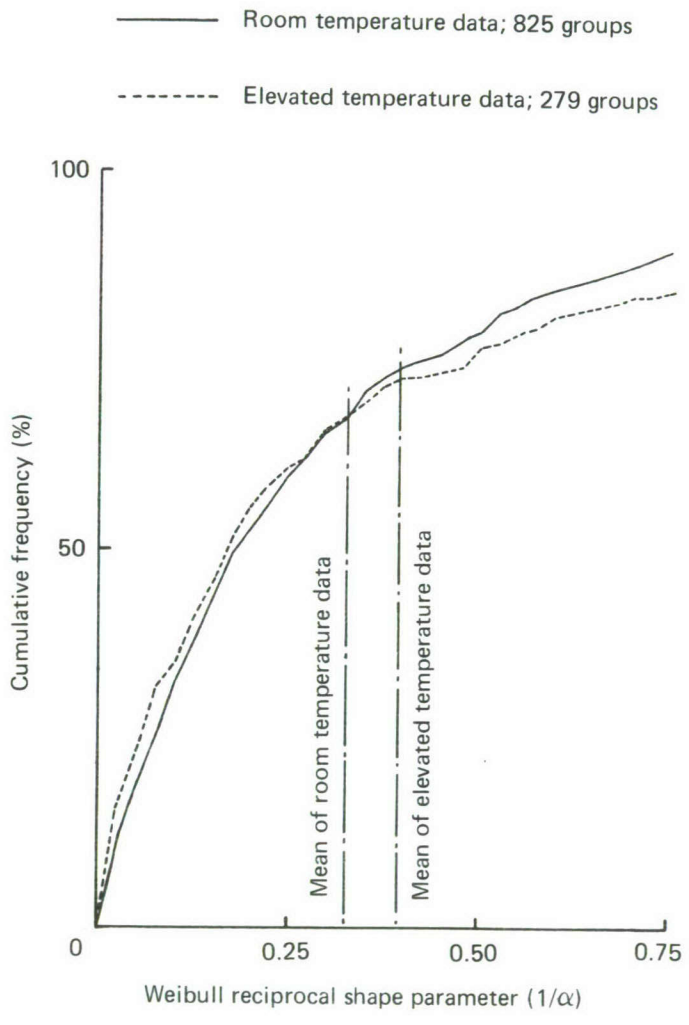

Figure 3. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Different Test Temperatures— Titanium

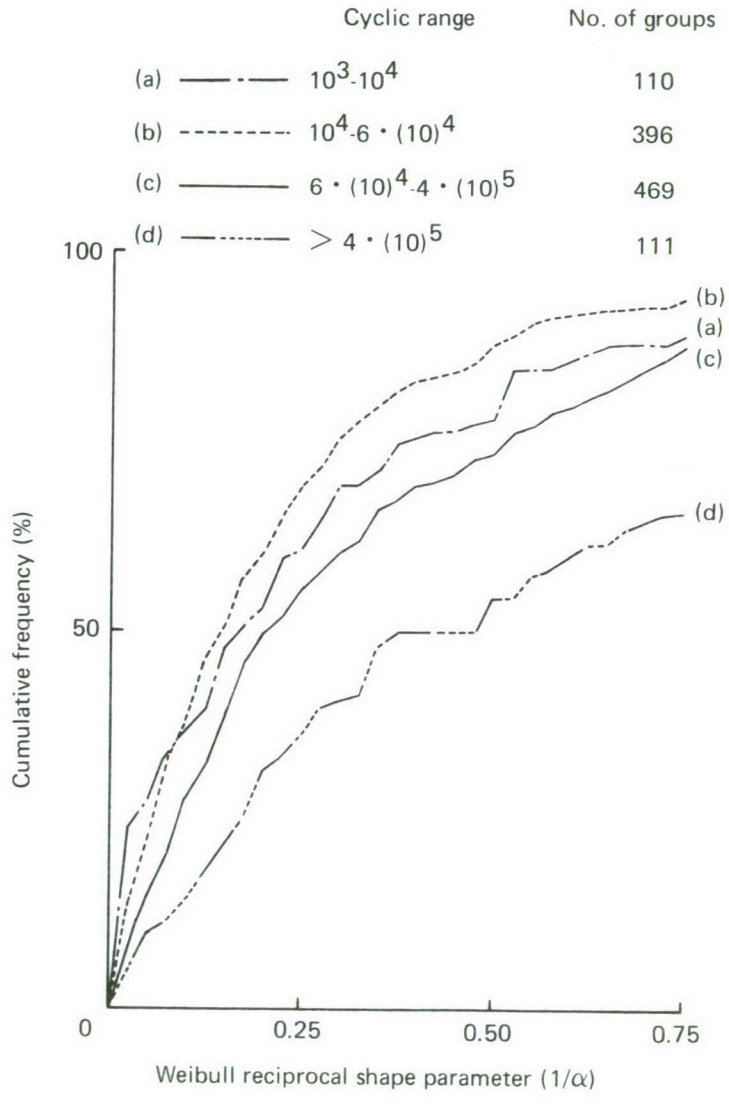

Figure 4. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Various Ranges of Test Life— Titanium

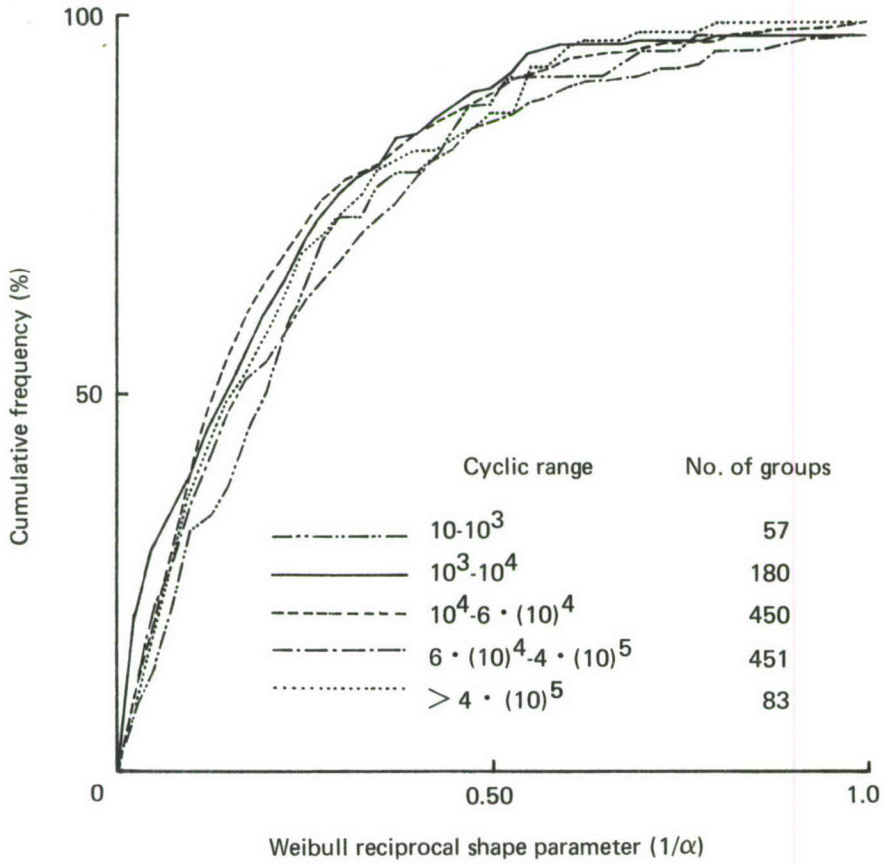

Figure 5. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Various Ranges of Test Life—Aluminum

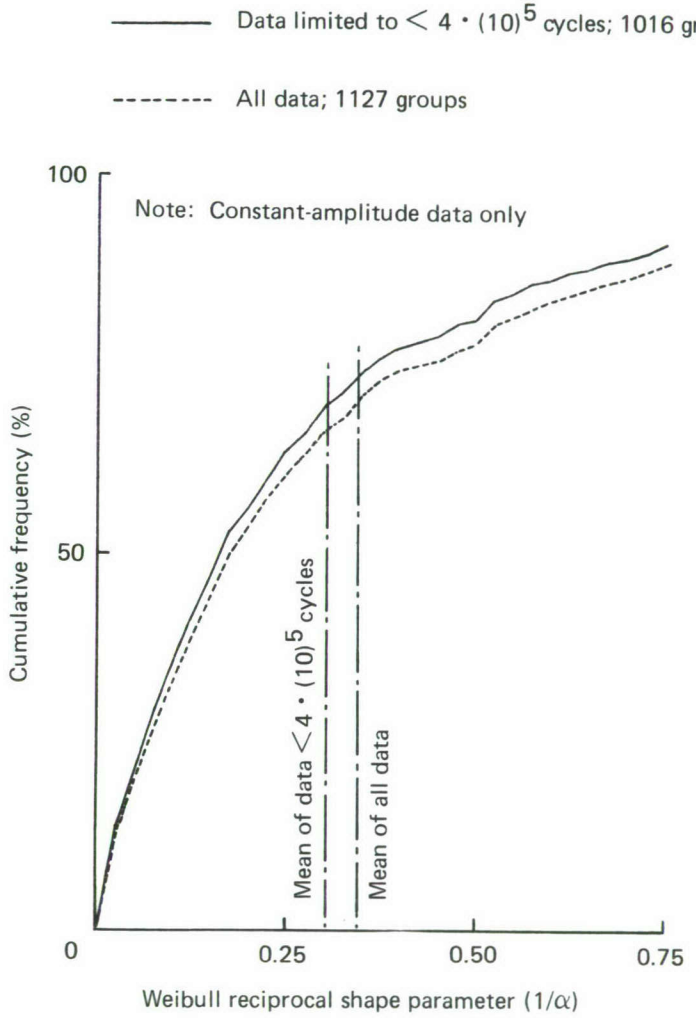

Figure 6. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Constant-Amplitude Titanium Data

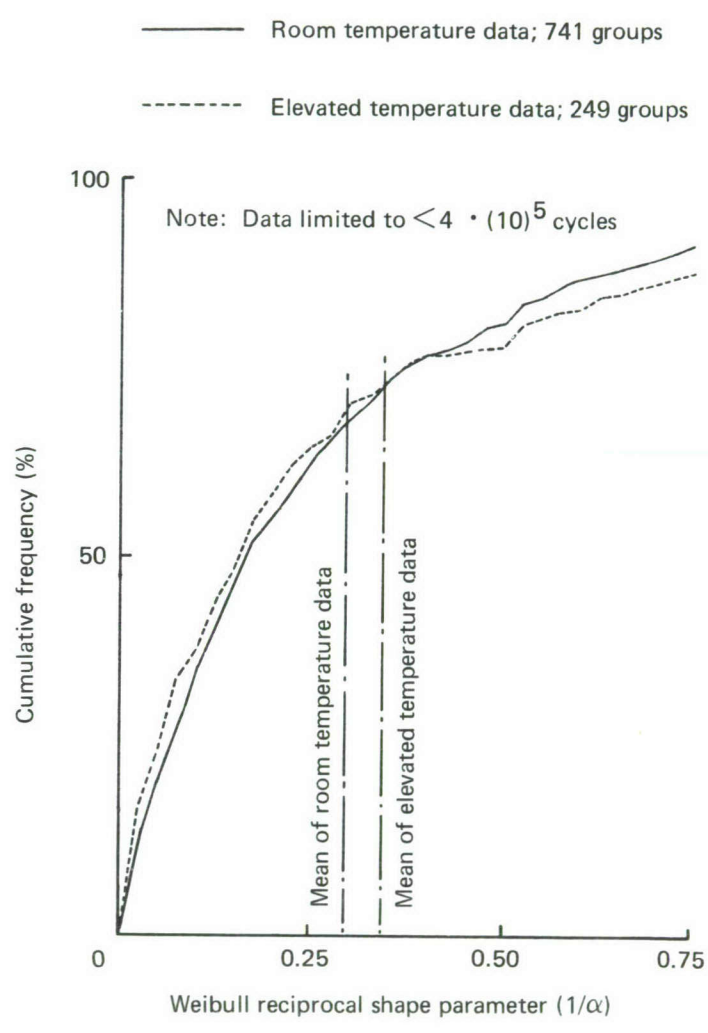

Figure 7. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Constant-Amplitude Data at Two Test Temperatures—Titanium

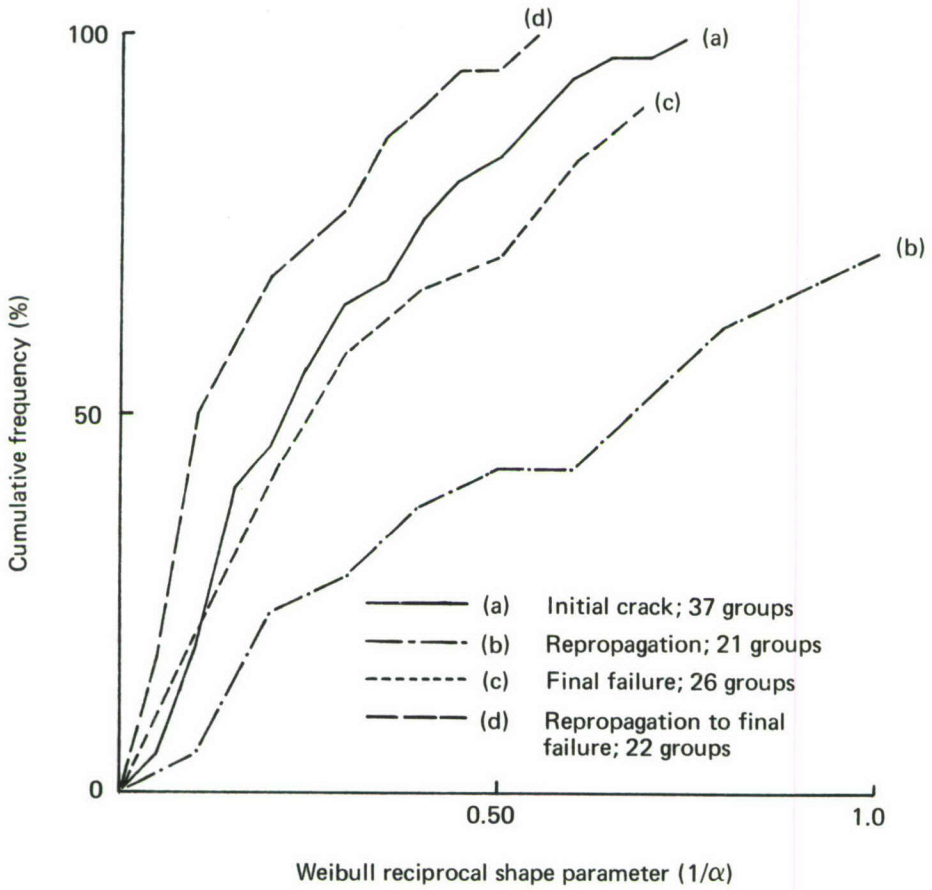

Figure 8. Comparison of the Distribution of Observed Estimates of the Weibull Reciprocal Shape Parameters for Crack Initiation and Propagation—Titanium

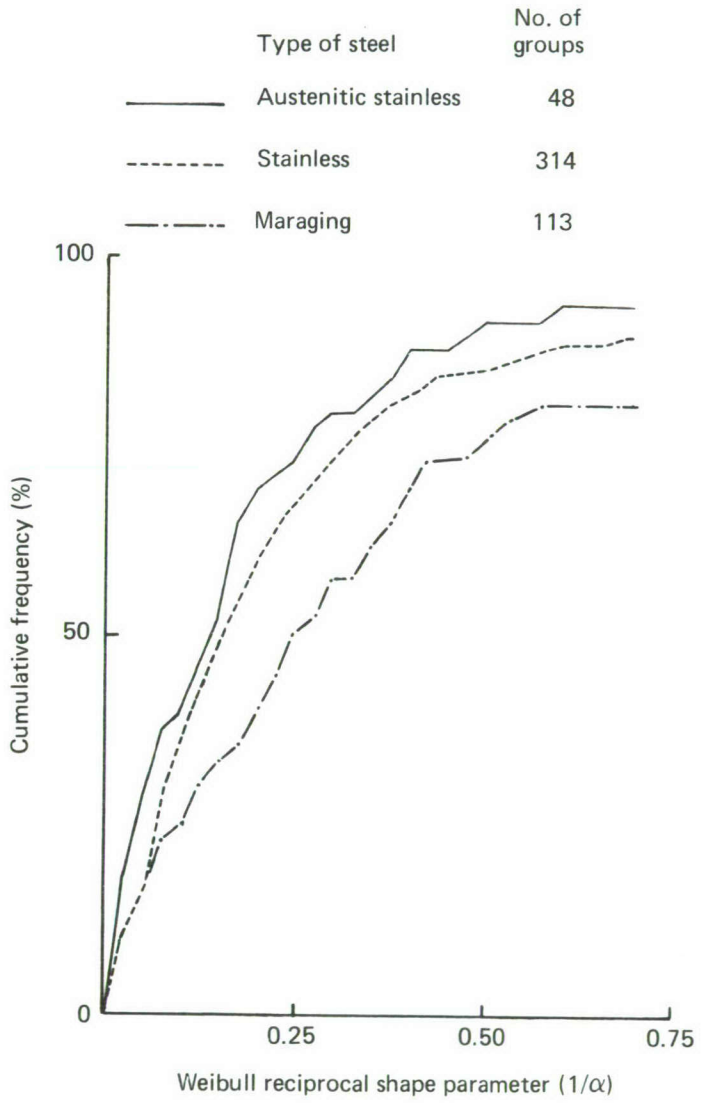

Figure 9. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Different Types of Steel

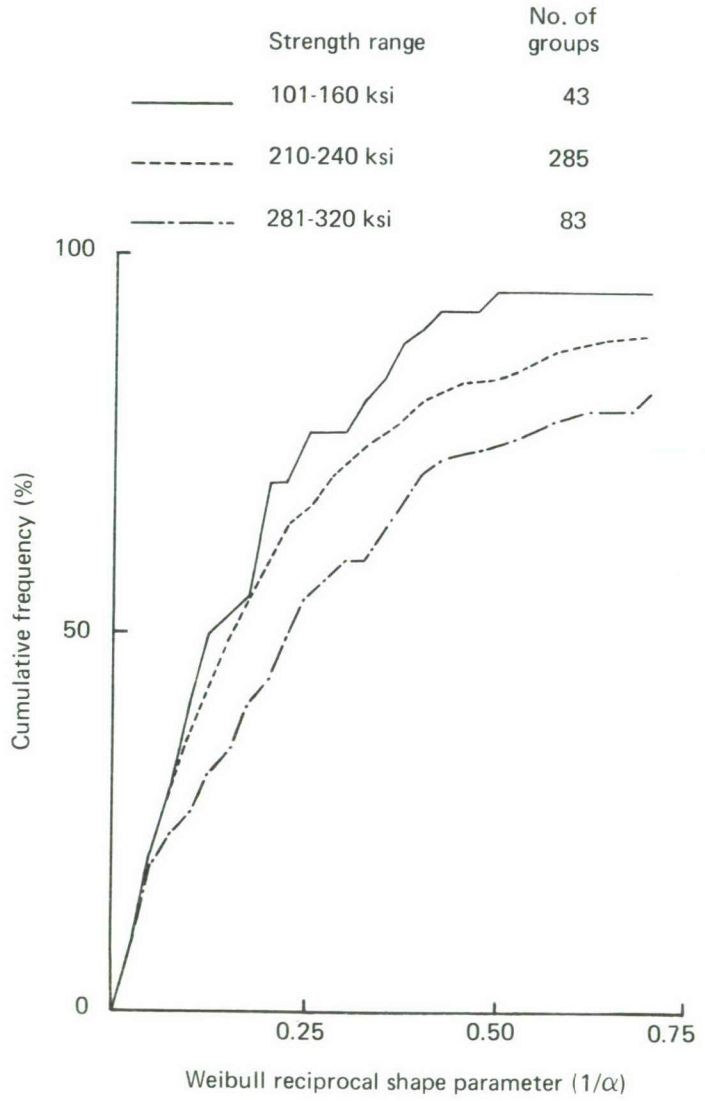

Figure 10. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Different Ranges of Strength—Steel

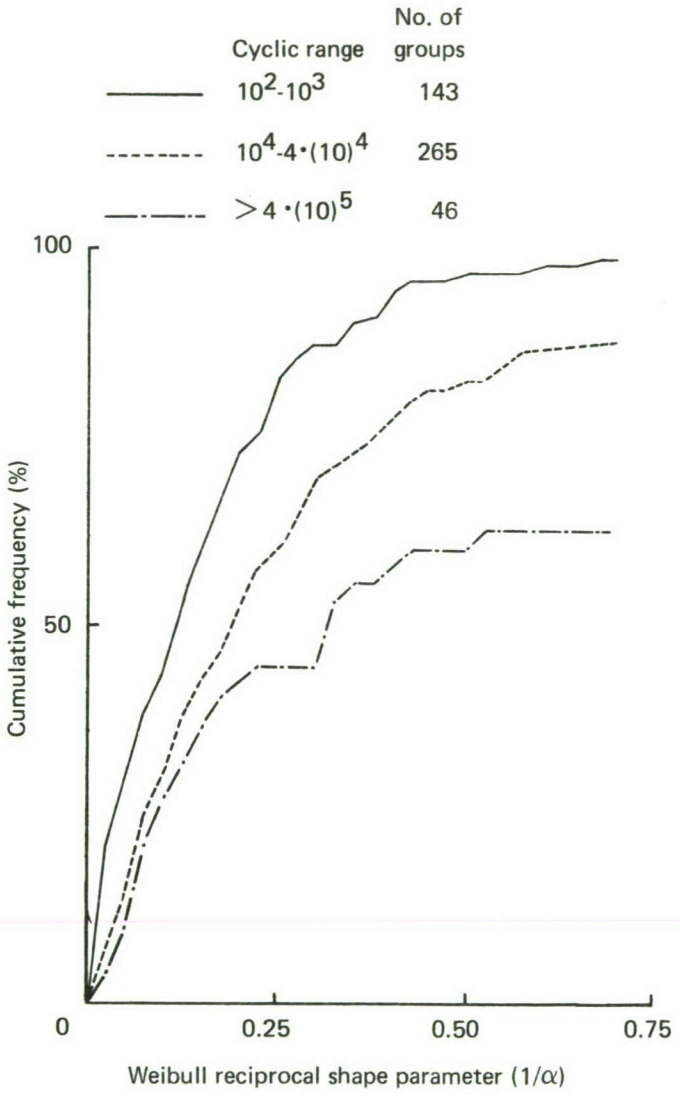

Figure 11. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Various Ranges of Test Life—Steel

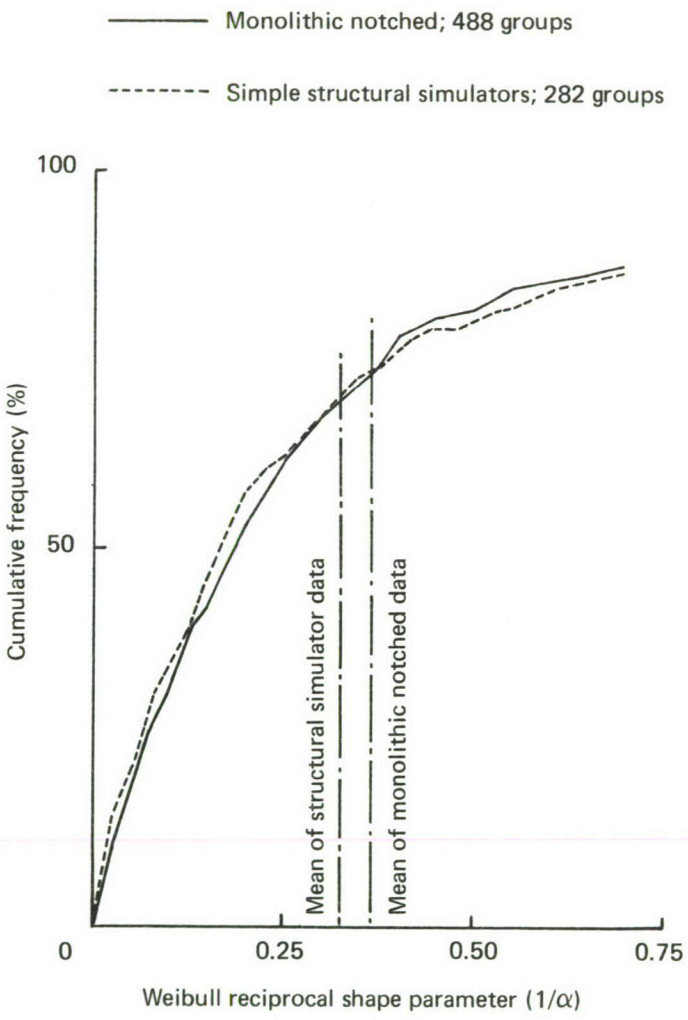

Figure 12. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters for Different Test Specimen Types—Steel

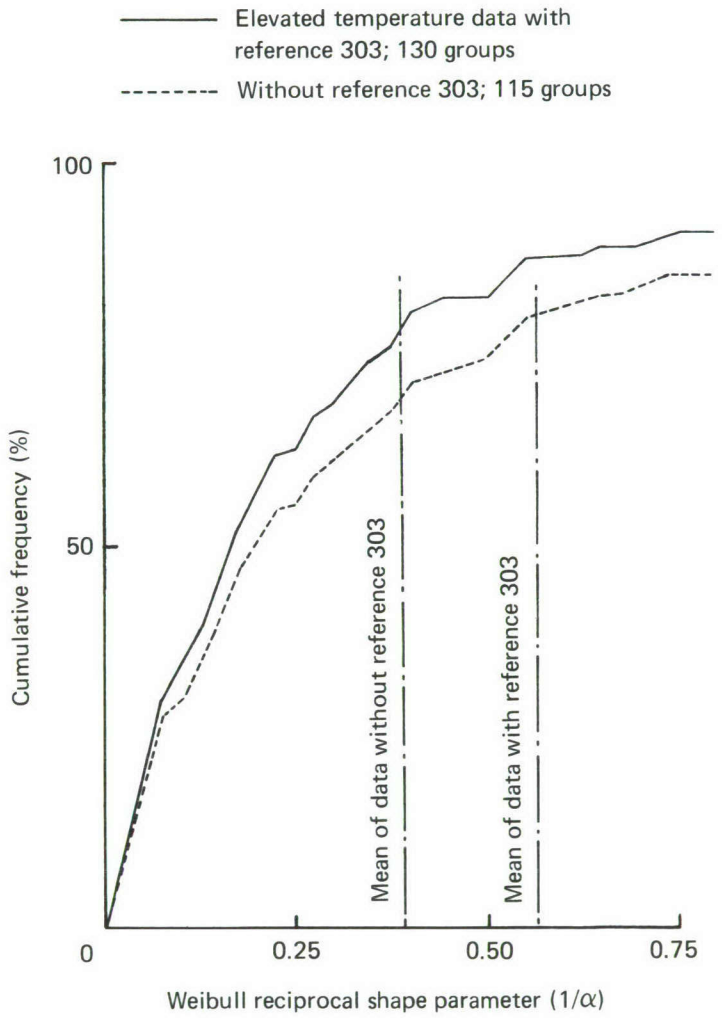

Figure 13. Effect of Reference 303 Data on Total Elevated Temperature Data Sample—Steel

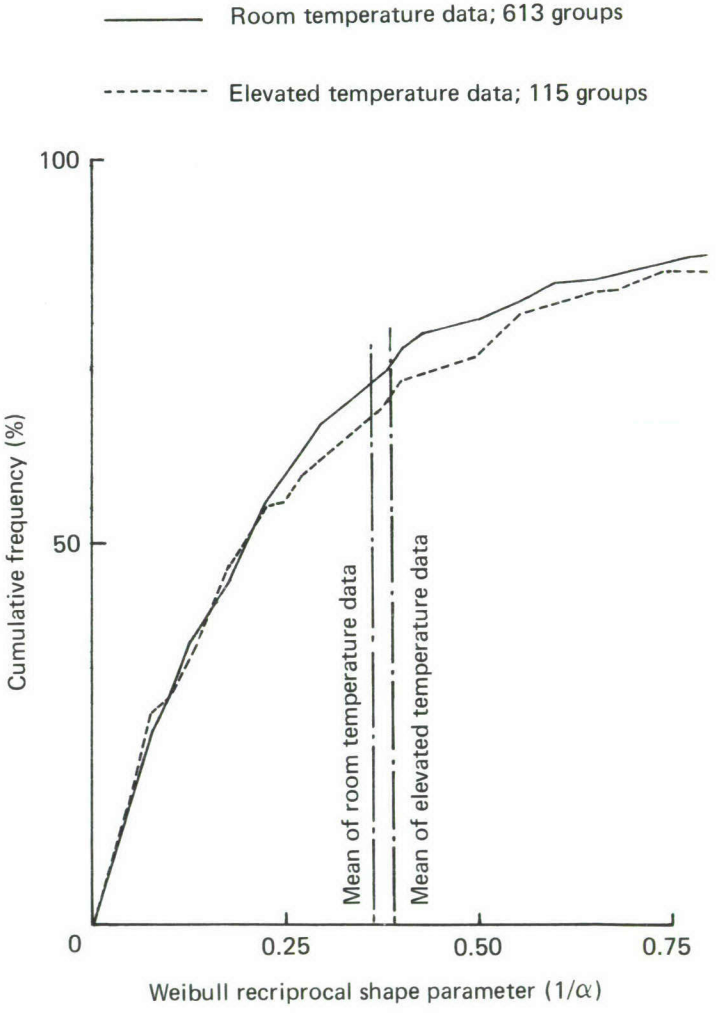

Figure 14. Comparison of the Distributions of Observed Estimates of the Weibull Reciprocal Shape Parameters from Data at Room and Elevated Temperatures—Steel

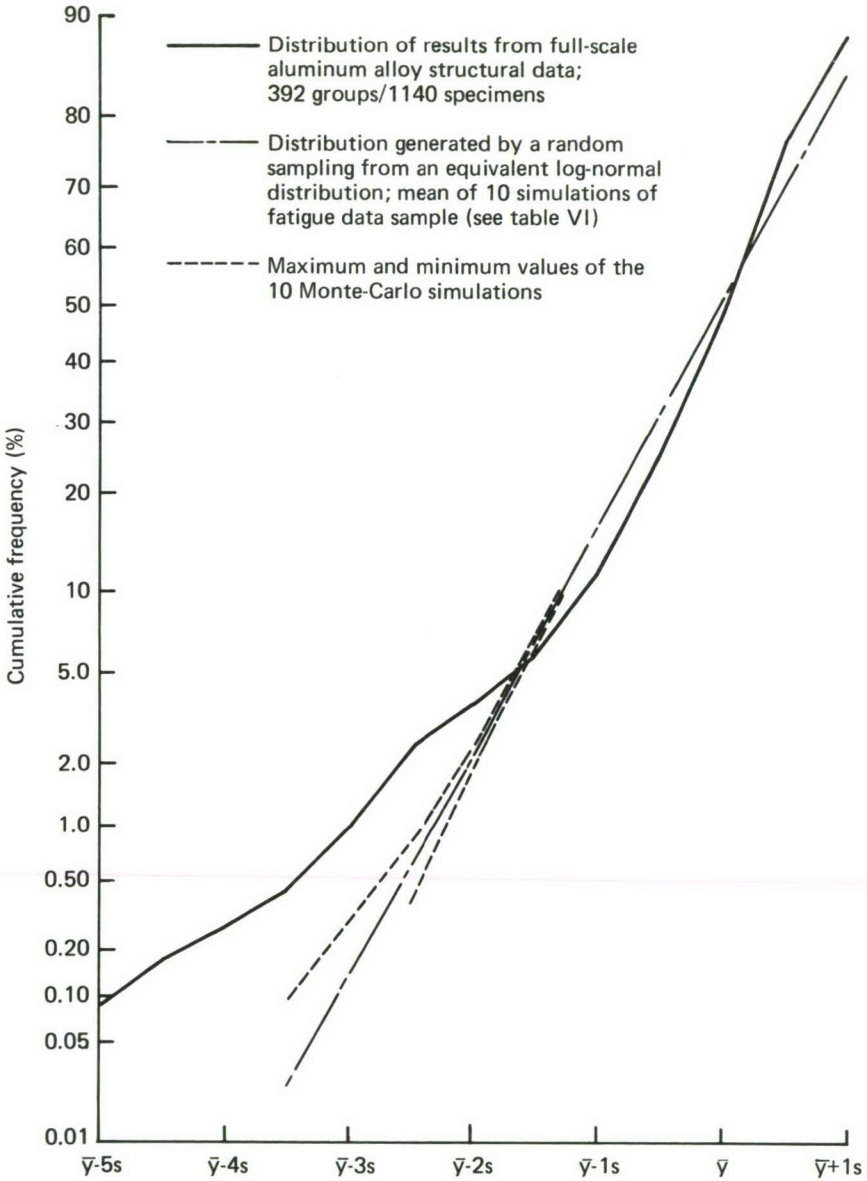

Figure 15. Structures Data (Log-Normal Simulation)

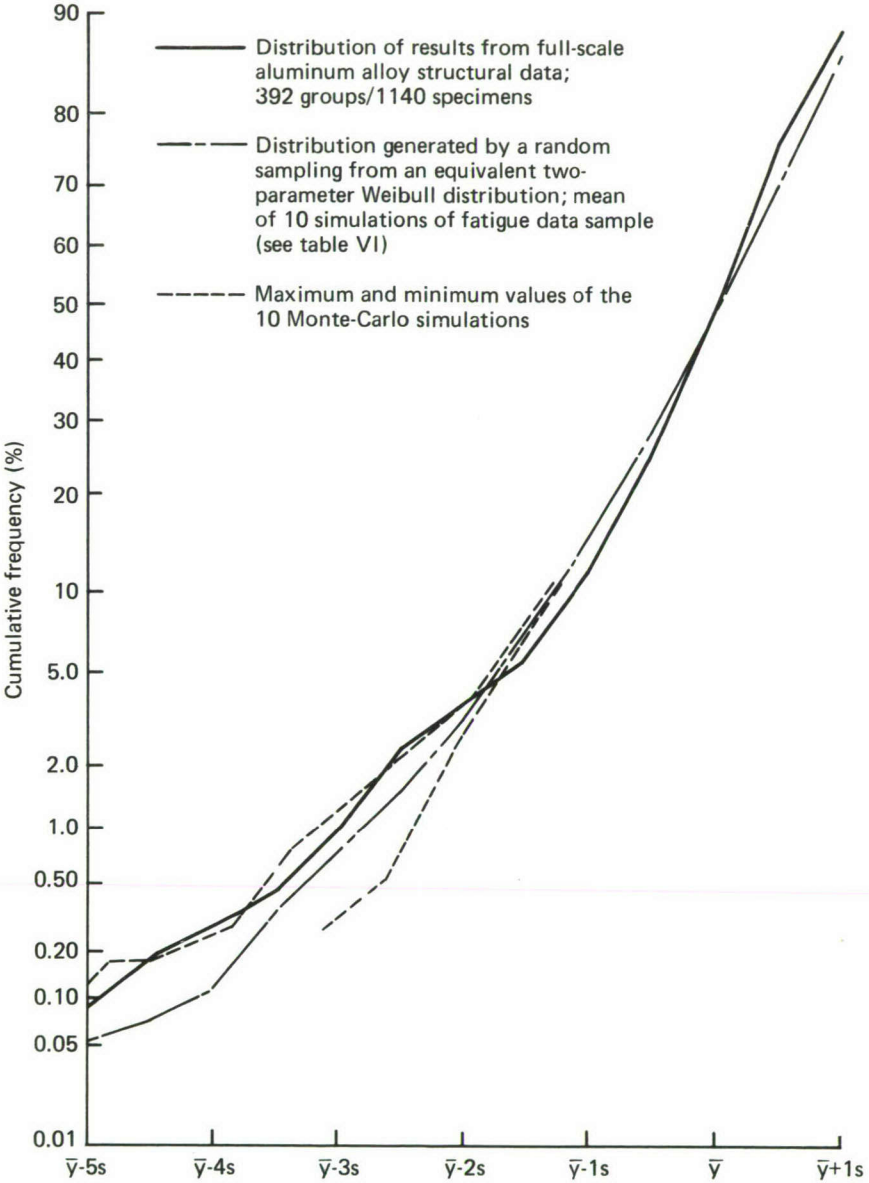

Figure 16. Structures Data (Weibull Simulation)

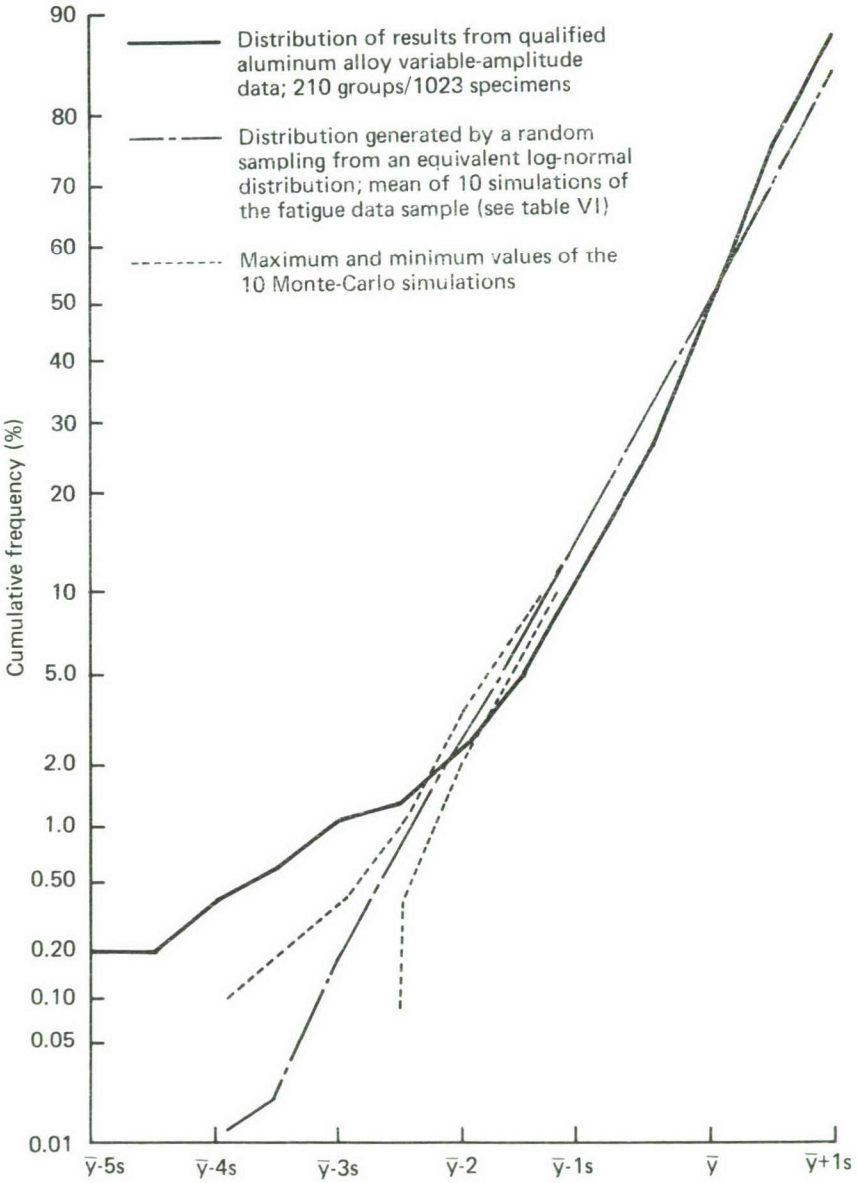

Figure 17. Variable-Amplitude Data (Log-Normal Simulation)

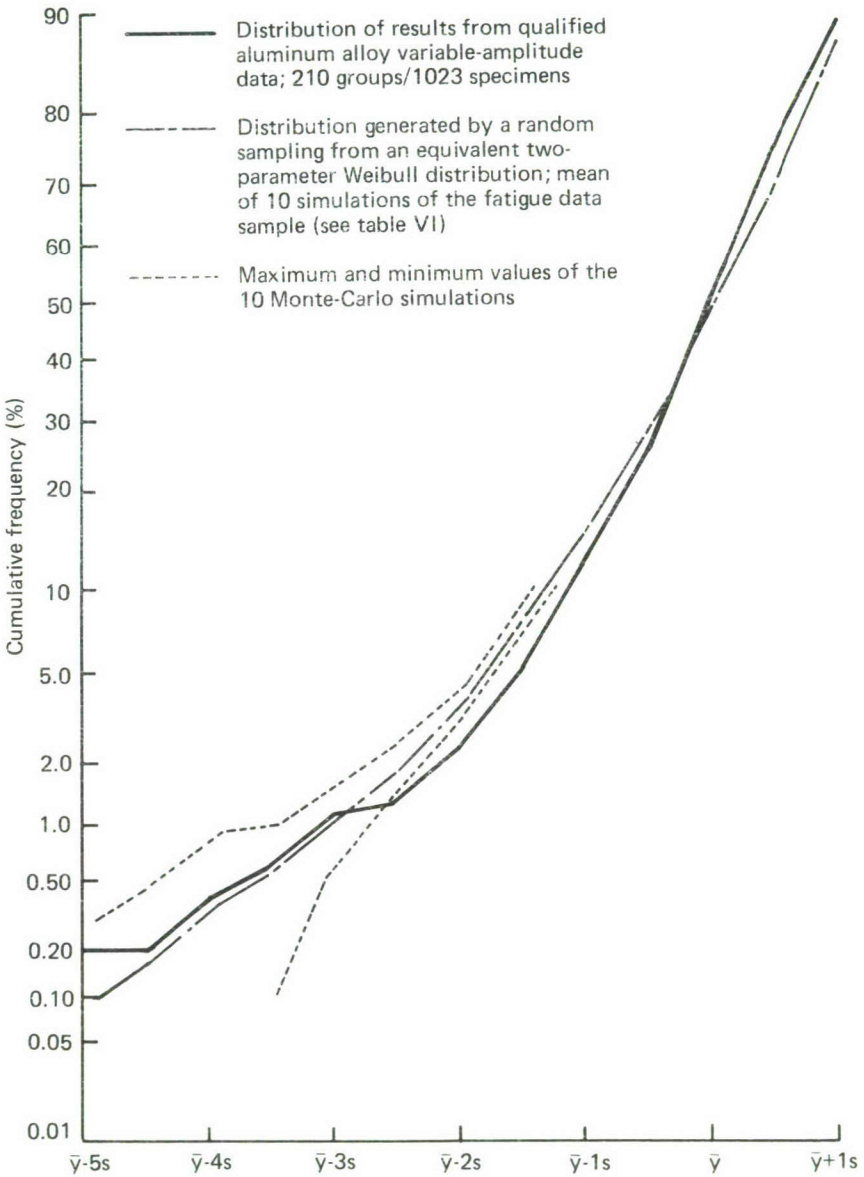

Figure 18. Variable-Amplitude Data (Weibull Simulation)

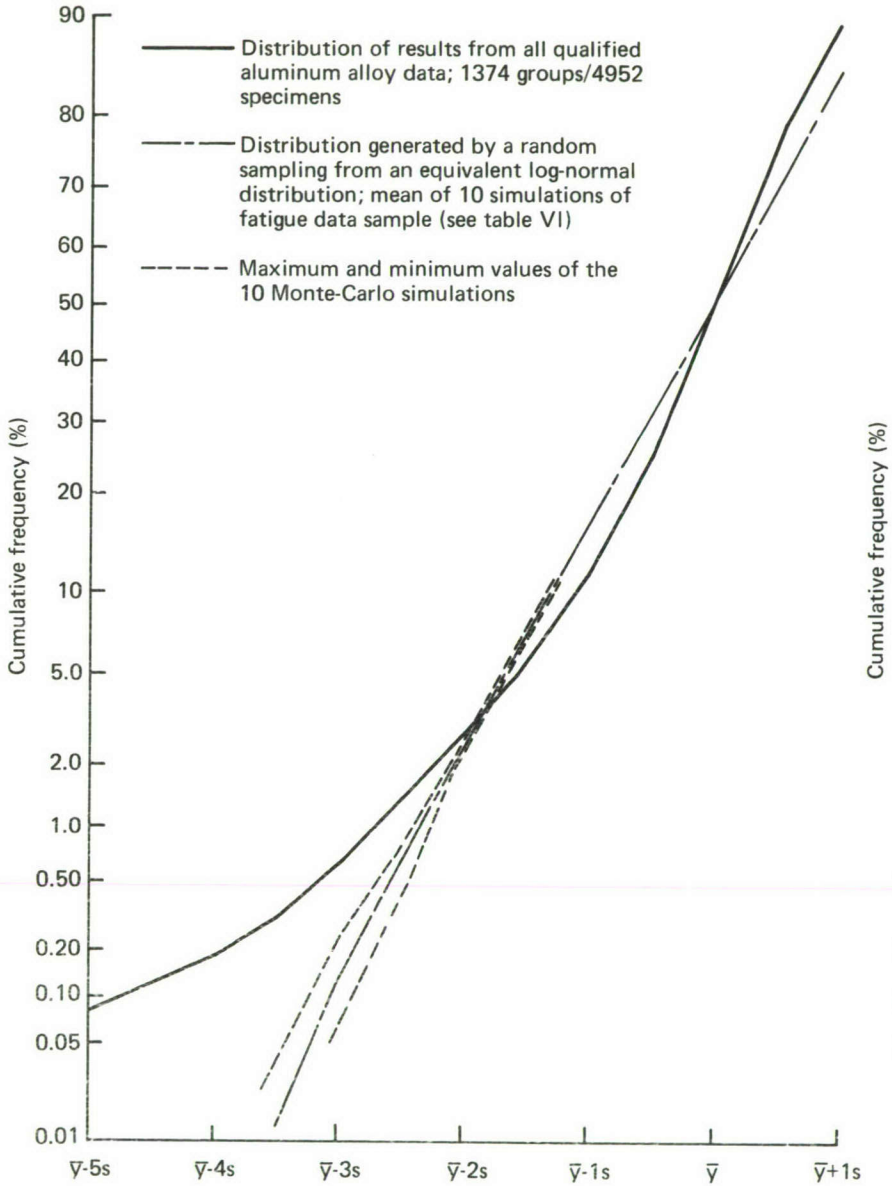

Figure 19. Aluminum Qualified Data (Log-Normal Simulation)

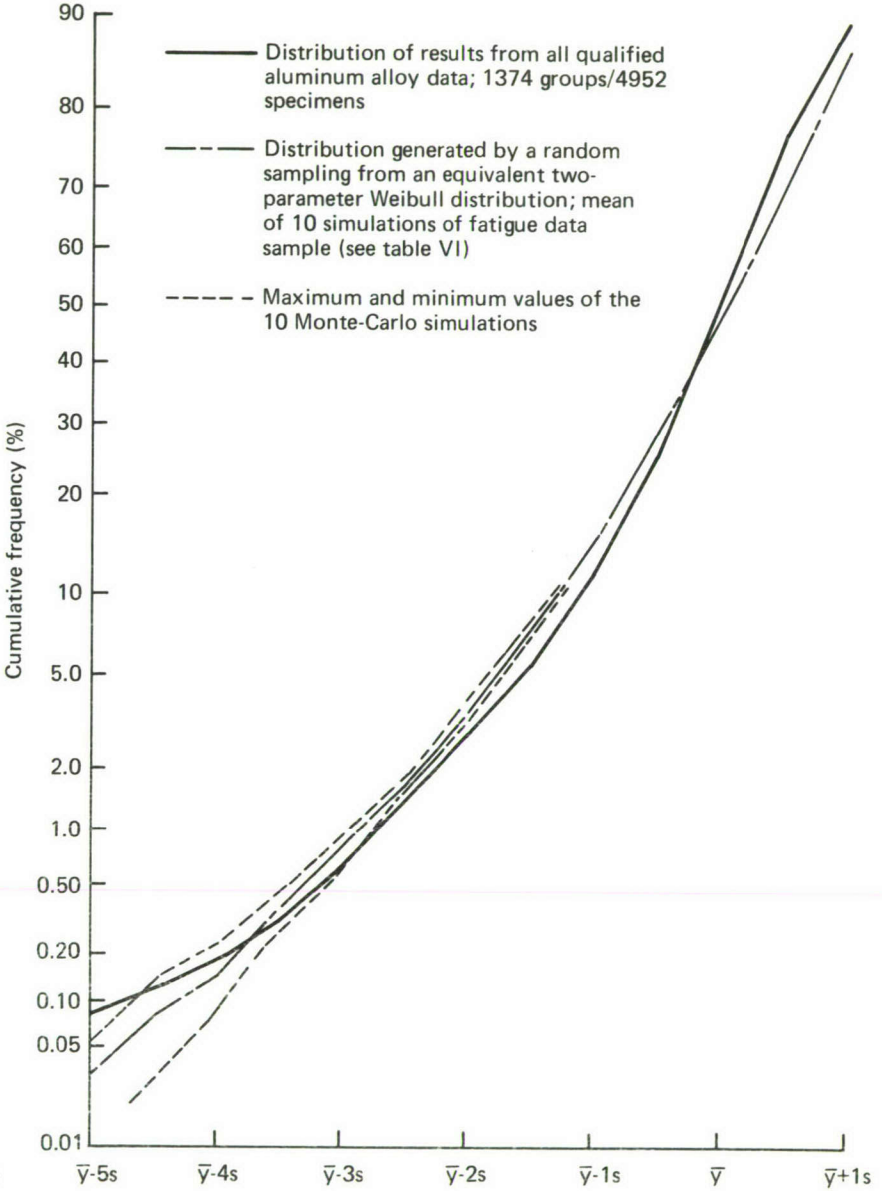

Figure 20. Aluminum Qualified Data (Weibull Simulation)

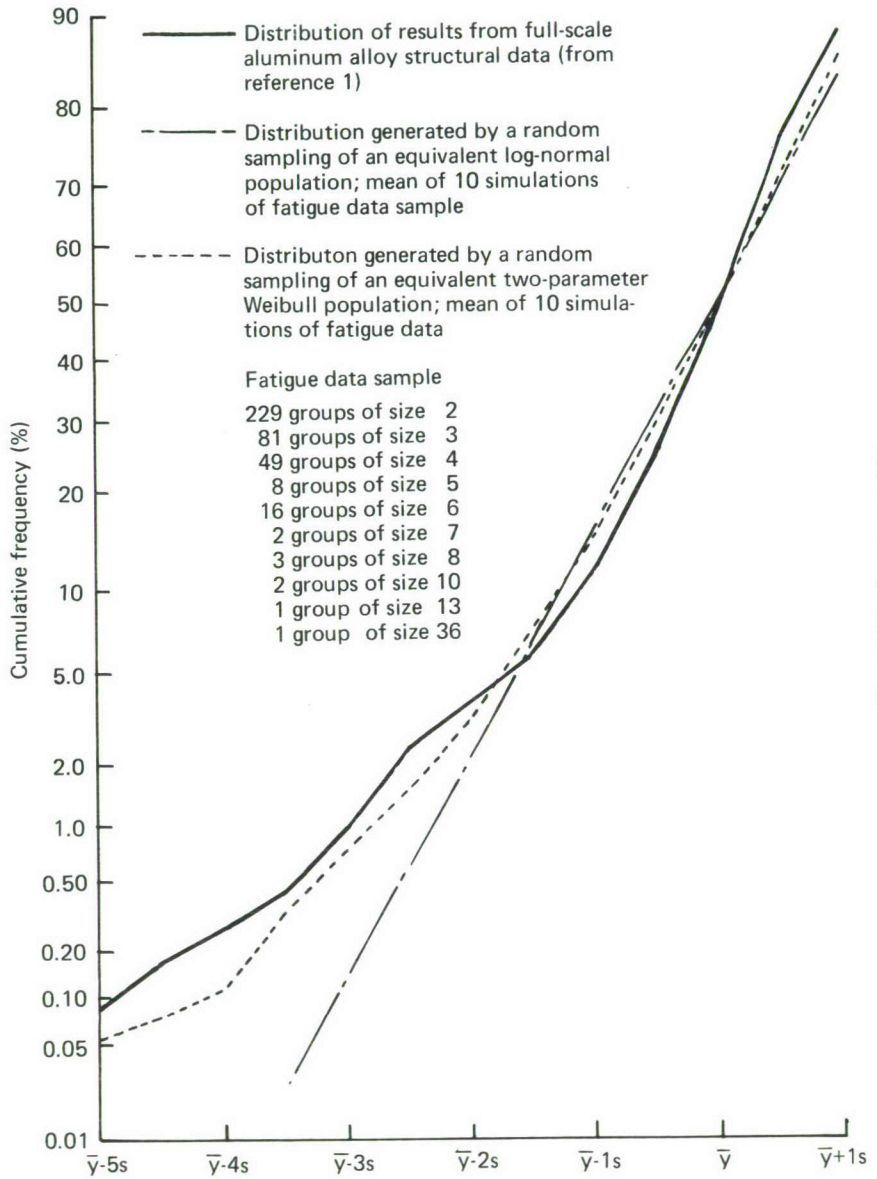

Figure 21. Structures Data

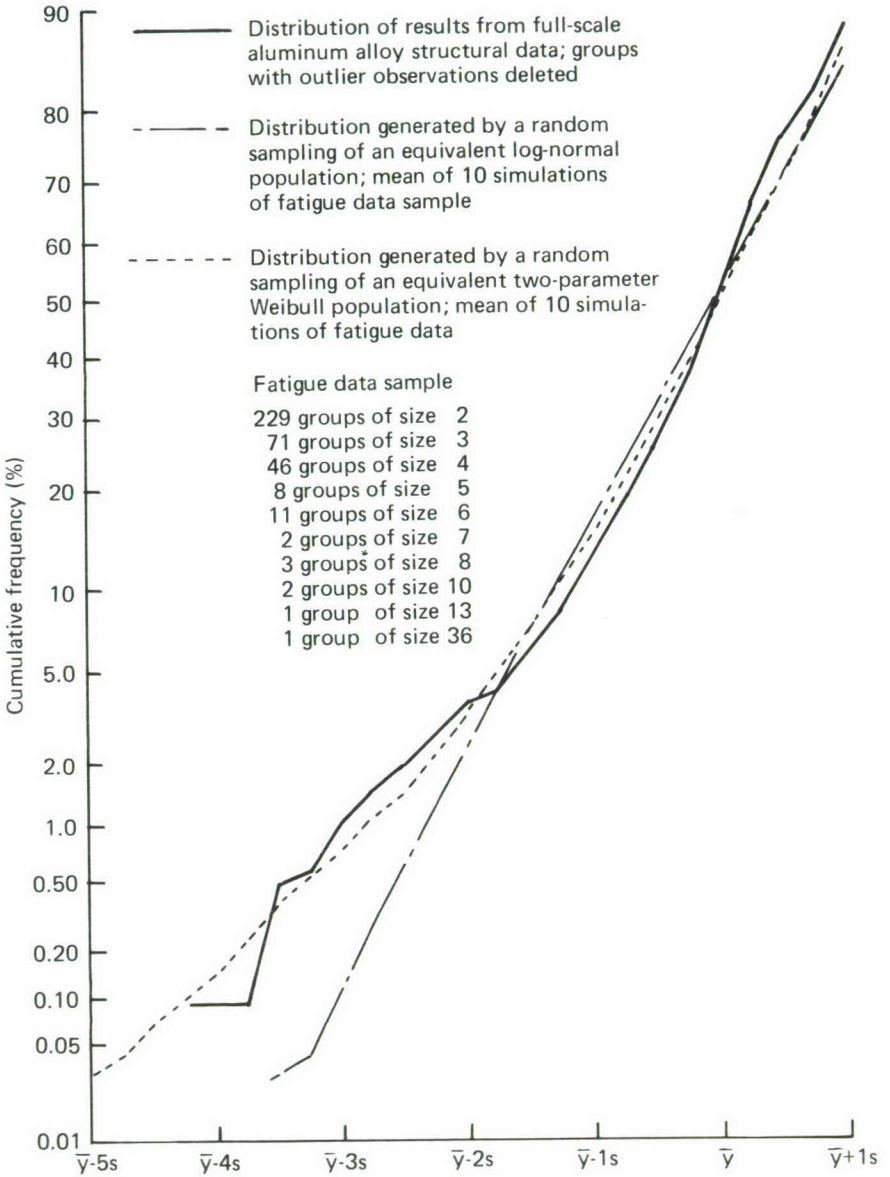

Figure 22. Structures Data (Groups Containing Outliers Deleted from Sample)

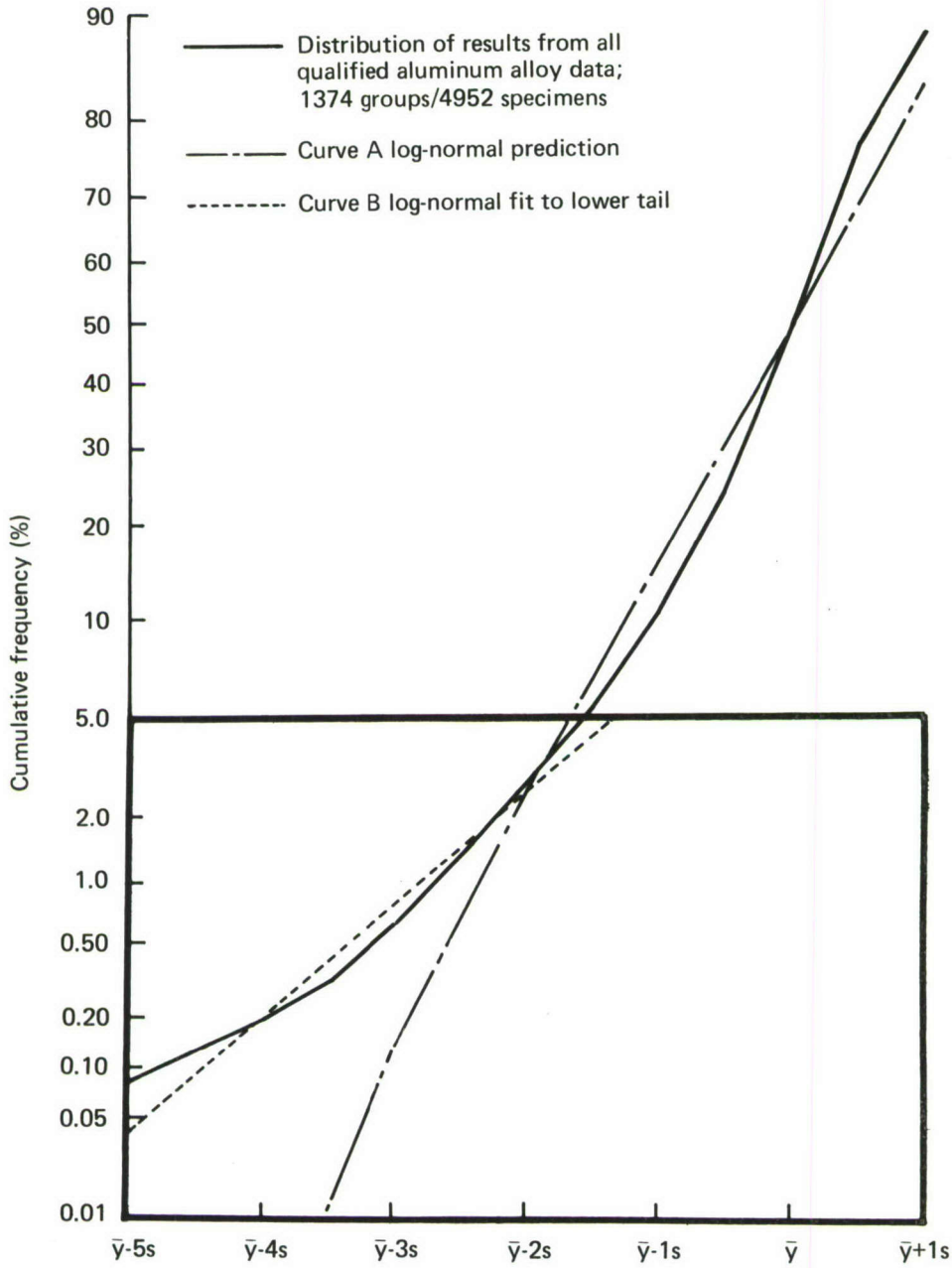

Figure 23. All Qualified Aluminum Alloy Data

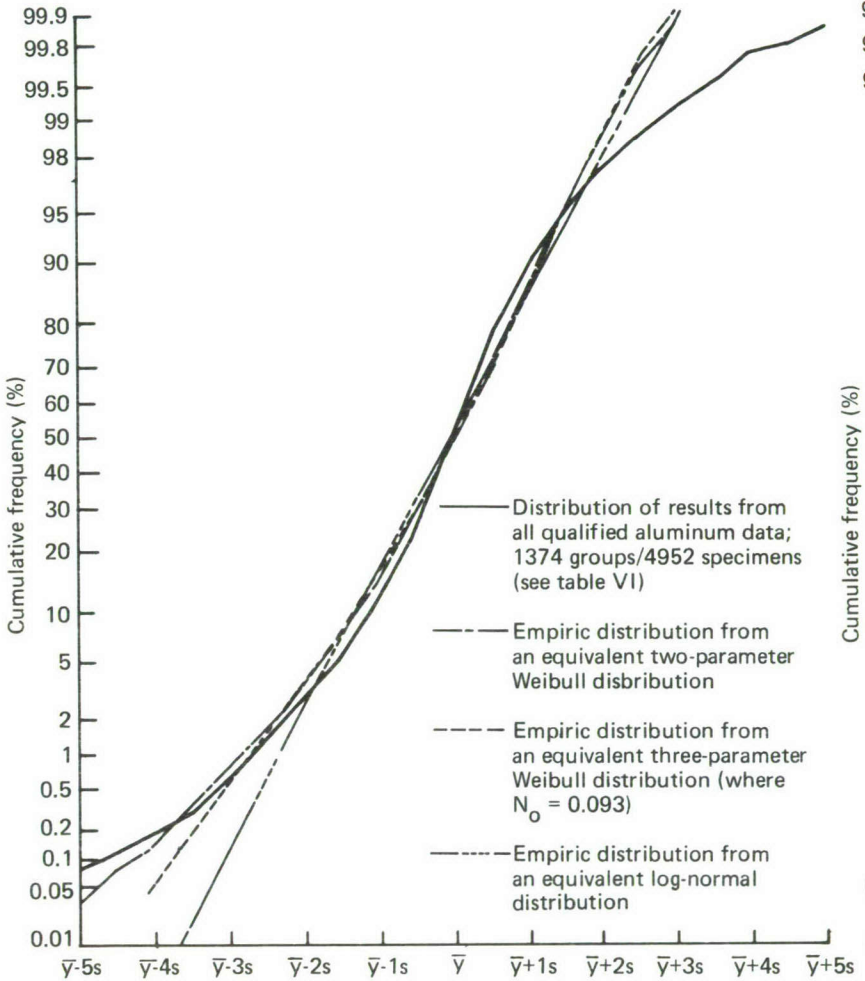

Figure 24. All Qualified Aluminum Alloy Data (Compared to Various Distribution Models)

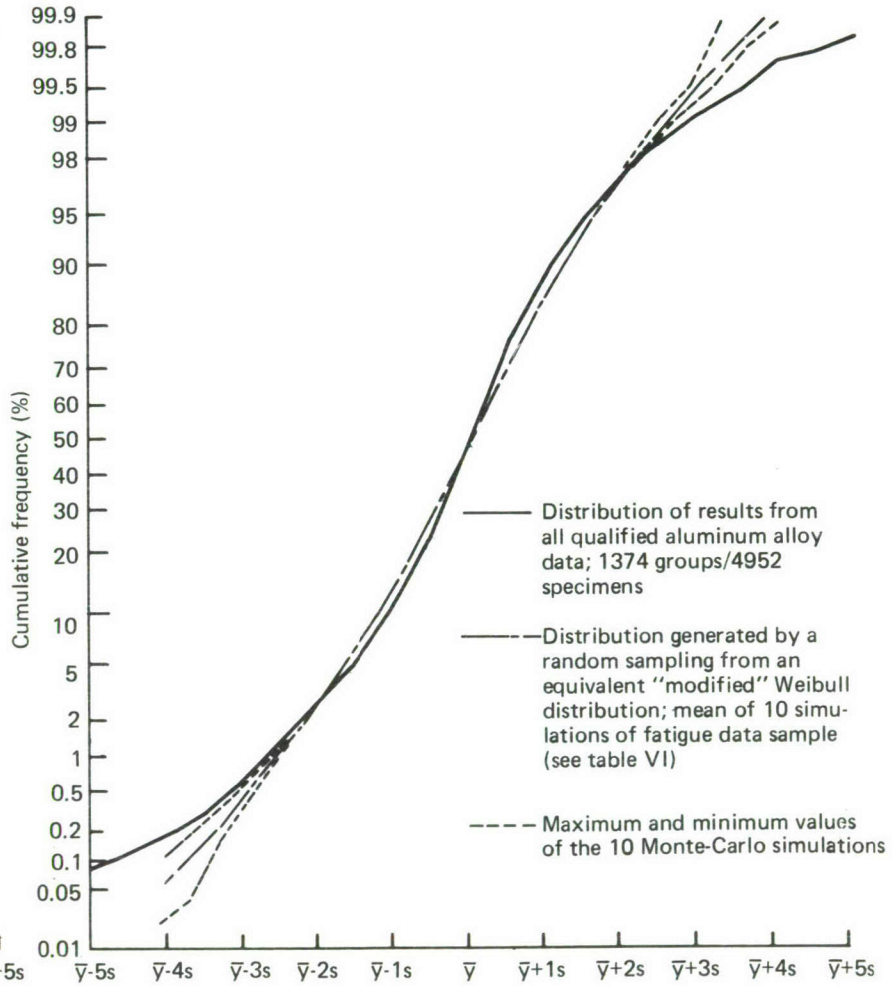

Figure 25. All Qualified Aluminum Alloy Data (Modified Weibull Simulation)

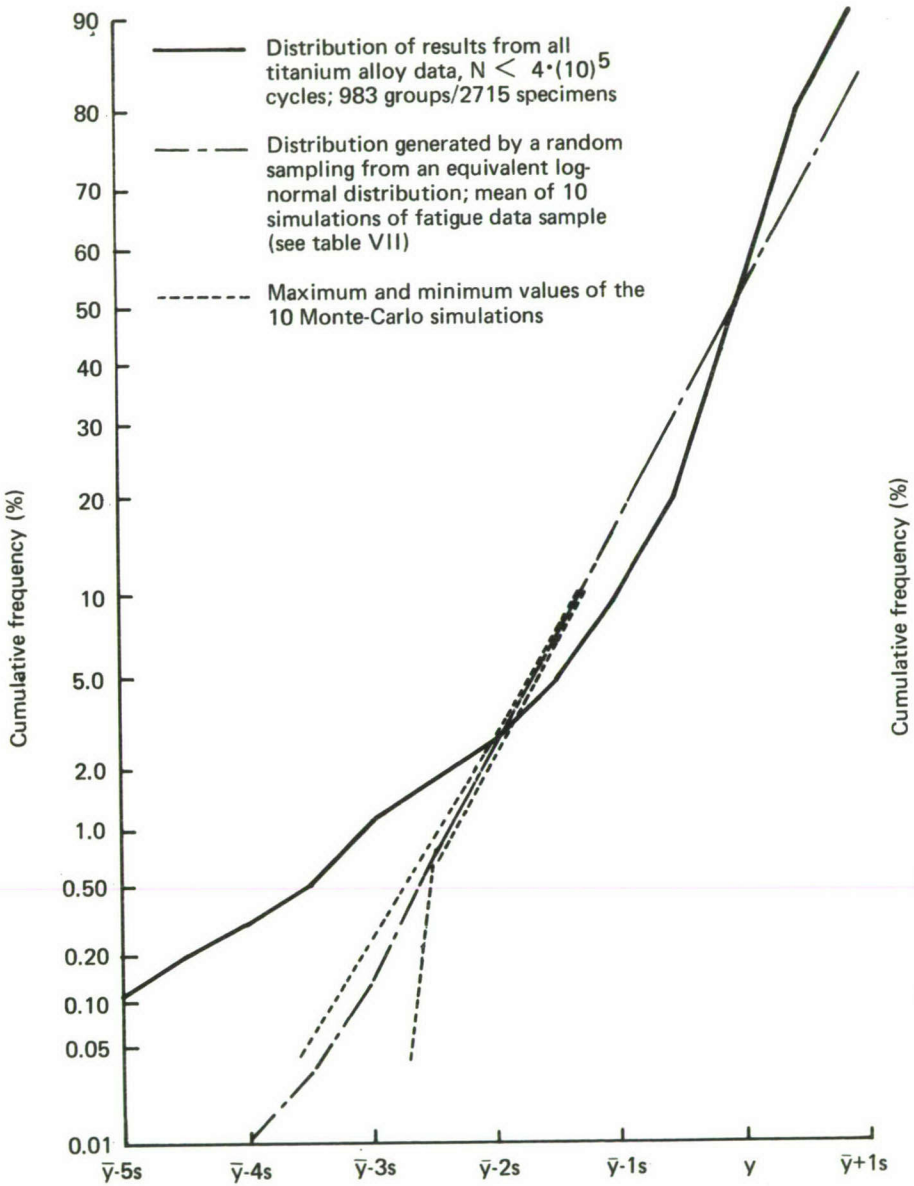

Figure 26. Titanium Alloy Data (Log-Normal Simulation)

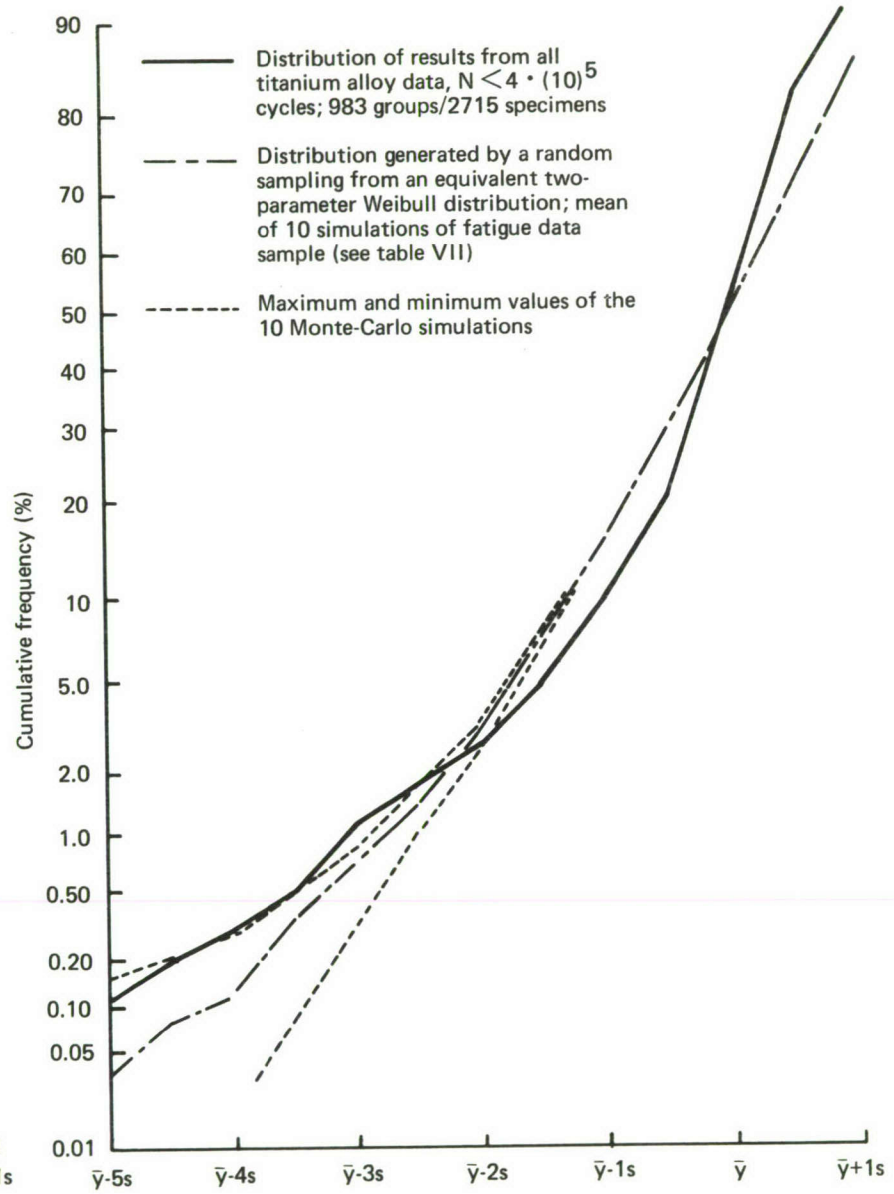

Figure 27. Titanium Alloy Data (Weibull Simulation)

Table I.—Results of Analyses Determining the Typical Shape Parameters for Fatigue Performance of Titanium Alloys

Data description	All data			Data below $4.(10)^5$ cycles		
	Number of groups	$1/\alpha$	α	Number of groups	$1/\alpha$	α
Titanium 6Al-4V	541	0.356	2.81	487	0.317	3.15
Titanium 8Al-1Mo-1V	586	0.326	3.07	529	0.291	3.44
Monolithic notched	637	0.341	2.93	581	0.300	3.33
Structures	Negligible	–	–	Negligible	–	–
Structural simulators	488	0.340	2.94	433	0.308	3.25
Room temperature	825	0.327	3.06	744	0.294	3.40
Elevated temperature	279	0.396	2.53	249	0.344	2.91
Low temperature	Negligible	–	–	Negligible	–	–
Constant amplitude	1056	0.353	2.83	945	0.315	3.17
Variable amplitude	71	0.139	7.19	71	0.139	7.19
All data	1127	0.341	2.93	1016	0.303	3.30
10^2-10^3 cycles	Negligible	–	–	Negligible	–	–
10^3-10^4 cycles	110	0.308	3.25	110	0.308	3.25
10^4-$6\cdot(10)^4$ cycles	396	0.249	4.02	396	0.249	4.02
$6\cdot(10)^4$-$4\cdot(10)^5$ cycles	429	0.381	2.62	429	0.381	2.62
$> 4\cdot(10)^5$ cycles	111	0.679	1.47	–	–	–

Table II.—Results of Analyses Determining the Typical Shape Parameters for Fatigue Performance of High-Strength Steels

Data description	All data		
	Number of groups	$1/\alpha$	α
Alloy steels	168	0.339	2.95
Intermediate alloys	111	0.433	2.31
18% Ni maraging steels	113	0.485	2.06
Stainless steels	314	0.304	3.29
Austenitic stainless steel	48	0.207	4.83
Air melted	44	0.306	3.27
Vacuum melted	94	0.397	2.52
0-100 ksi	43	0.296	3.38
101-160 ksi	43	0.193	5.18
161-200 ksi	131	0.240	4.17
201-240 ksi	285	0.316	3.16
241-280 ksi	132	0.455	2.20
281-320 ksi	83	0.468	2.14
321-360 ksi	—	—	—
Monolithic notched	488	0.368	2.72
Structures	—	—	—
Structure simulators	282	0.322	3.11
Room temperature	613	0.354	2.82
Elevated temperature	115	0.392	2.55
Low temperature	Negligible	—	—
Constant amplitude	770	0.352	2.84
Variable amplitude	Negligible	—	—
All data	770	0.352	2.84
10^2-10^3 cycles	143	0.157	6.37
10^3-10^4 cycles	127	0.267	3.75
10^4-$6 \cdot (10)^4$ cycles	265	0.387	2.58
$6 \cdot (10)^4$-$4 \cdot (10)^5$ cycles	189	0.452	2.21
$>4 \cdot (10)^5$ cycles	46	0.585	1.71

Table III.—Typical Shape Parameters for Fatigue Performance of High-Strength Steels Varying with Strength Ranges (i), (ii), and (iii)

Data description		All data		
		Number of groups	$1/\alpha$	α
(i)	161-200 ksi	131	0.240	4.17
	Alloy steels	37	0.300	3.33
	Intermediate alloys	Negligible	—	—
	18% Ni maraging steels	—	—	—
	Stainless steels	91	0.199	5.03
	Austenitic stainless steel	—	—	—
(ii)	201-240 ksi	285	0.316	3.16
	Alloy steels	Negligible	—	—
	Intermediate alloys	24	0.118	8.47
	18% Ni maraging steels	—	—	—
	Stainless steels	204	0.345	2.90
	Austenitic stainless steel	48	0.207	4.83
(iii)	241-280 ksi	132	0.455	2.20
	Alloy steels	47	0.341	2.93
	Intermediate alloys	75	0.509	1.96
	18% Ni maraging steels	Negligible	—	—
	Stainless steels	—	—	—
	Austenitic stainless steel	—	—	—

Table IV.—Typical Shape Parameters for Fatigue Performance of Stainless Steels Varying with Strength (i) and Life (ii)

	Data description	Stainless steels		
		Number of groups	$1/\alpha$	α
	All data	314	0.304	3.29
(i)	0-100 ksi	Negligible	–	–
	101-160 ksi	–	–	–
	161-200 ksi	91	0.199	5.03
	201-240 ksi	204	0.345	2.90
	241-280 ksi	–	–	–
	281-320 ksi	Negligible	–	–
	321-360 ksi	–	–	–
(ii)	10^2-10^3 cycles	66	0.154	6.49
	10^3-10^4 cycles	49	0.254	3.94
	10^4-$6 \cdot (10)^4$ cycles	109	0.361	2.77
	$6 \cdot (10)^4$-$4 \cdot (10)^5$ cycles	66	0.296	3.38
	$> 4 \cdot (10)^5$ cycles	24	0.554	1.81

Table V.—Typical Shape Parameters for Fatigue Performance of High-Strength Steels with Strengths Equal to or Less Than 240 ksi (i) and Greater Than 240 ksi (ii)

	Data description	All data		
		Number of groups	$1/\alpha$	α
(i)	Strength $\leqslant$ 240 ksi	502	0.285	3.51
	10^2-10^3 cycles	98	0.159	6.29
	10^3-10^4 cycles	72	0.236	4.24
	10^4-$6 \cdot (10)^4$ cycles	157	0.312	3.21
	$6 \cdot (10)^4$-$4 \cdot (10)^5$ cycles	135	0.297	3.37
	$>4 \cdot (10)^5$ cycles	40	0.516	1.94
(ii)	Strength $>$240 ksi	215	0.460	2.17
	10^2-10^3 cycles	45	0.154	6.49
	10^3-10^4 cycles	43	0.309	3.24
	10^4-$6 \cdot (10)^4$ cycles	82	0.523	1.91
	$6 \cdot (10)^4$-$4 \cdot (10)^5$ cycles	39	0.765	1.31
	$>4 \cdot (10)^5$ cycles	Negligible	–	–

Table VI.—Aluminum Alloy Data Samples

Full-scale structural data sample			Variable-amplitude data sample			All qualified data sample		
Groups in data sample	Specimens in each group	Specimens in data sample	Groups in data sample	Specimens in each group	Specimens in data sample	Groups in data sample	Specimens in each group	Specimens in data sample
229	2	458	84	2	168	510	2	1020
81	3	243	27	3	81	340	3	1020
49	4	196	13	4	52	250	4	1000
8	5	40	28	5	140	136	5	680
16	6	96	7	6	42	44	6	264
2	7	14	12	7	84	22	7	154
3	8	24	5	8	40	14	8	112
0	9	0	6	9	54	9	9	81
2	10	20	21	10	210	31	10	310
0	11	0	0	11	0	2	11	22
0	12	0	0	12	0	3	12	36
1	13	13	2	13	26	4	13	52
0	15	0	0	15	0	1	15	15
0	20	0	3	20	60	6	20	120
0	30	0	1	30	30	1	30	30
1	36	36	1	36	36	1	36	36
392		1140	210		1023	1374		4952

Table VII.—Titanium Alloy Data Sample

All data, $N < 4.(10)^5$ cycles		
Groups in data sample	Specimens in each group	Total specimens in data sample
520	2	1040
316	3	948
80	4	320
44	5	220
9	6	54
4	7	28
2	8	16
2	9	18
1	10	10
2	11	22
2	12	24
1	15	15
983		2715

Table VIII.—Comparison of Estimates from Extreme and Central Tendency Fatigue Data Using Two Different Distribution Models

	Maximum likelihood estimates of:				Remarks
	Shape parameter		Scale parameter		
	Log-normal σ	Weibull α	Log-normal	Weibull	
Central tendency fatigue data	0.051	10.85	54,000	56,900	Drill entry side holes
Fatigue data extremes	0.098	10.1	57,000	52,000	
Central tendency fatigue data	0.082	5.55	49,100	53,250	Drill exit side holes
Fatigue data extremes	0.181	5.26	59,500	50,200	

Ref. AFML-TR-70-157 Aug. 1970 (Table 9)

APPENDIX I

PROOF OF DISTRIBUTION EVALUATION STATISTIC

Let Ω be a class of functions defined as follows:

> $\psi \in \Omega$ iff ψ is a monotone increasing odd map of the real life onto itself which is twice differentiable and such that

$$\psi'' \leqslant \psi' \tag{1}$$

Say that the log-life variate X is ψ-normal iff there exist constants α, ν and a function $\psi \in \Omega$ such that

$$(1/\alpha)\ \psi\ (x - \nu) \sim N(0,1) \tag{2}$$

The idea is that for each prescribed stress level ℓ, there is a function ψ, which depends upon ℓ, which is in Ω.

Note that if the log-life X is ψ-normal as in (2), then

$$EX = \nu,$$

$$\text{var}(X) = E[\psi^{-1}(\alpha Z)]^2 = g_{\psi}(\alpha) \tag{3}$$

where Z is the standard normal variate, and

$$E\psi^2 (X - \nu) = \alpha^2. \tag{4}$$

The proof follows from (2) since $X = \nu + \psi^{-1}(\alpha Z)$ and ψ being 1-1 and odd (then so is its inverse), implying that $E\psi^{-1}(\alpha Z) = 0$. The formulas (3) and (4) are immediate.

Lemma: If x_i, i-1, . . . ,n, are independent observations with mean μ and variance σ^2, then

$$y_i = \sqrt{n/(n-1)}\,(x_i - \bar{x}), \quad i=1, \ldots, n$$

are a set of dependent observations but with zero mean and variance σ^2.

Proof: Clearly $Ey_i = 0$. Hence it is seen that

$$\text{var}(y_i) = \frac{n}{n-1}\,\text{var}(x_i - \bar{x}) = \frac{n}{n-1}\,\text{var}\left[\sum_{k=1}^{n}\left(\delta_{ik} - \frac{1}{n}\right)x_k\right]$$

$$= \frac{n}{n-1}\left[\left(1 - \frac{1}{n}\right)^2 + \frac{n-1}{n^2}\right]\sigma^2 = \sigma^2 .$$

Note that all the properties that are used in the calculation with the y's are contained in the more general definition:

$$y_i = \sum_{k=1}^{n} a_{ik} x_k$$

where

$$\sum_k a_{ik} = 0, \quad \sum_k a_{ik}^2 = 1, \quad a_{ik} = a_{ki}$$

In fact, the specification that has been made is

$$a_{ik} = \sqrt{n/(n-1)}\left(\delta_{ik} - \frac{1}{n}\right)$$

where δ_{ik} is the Kronecker delta.

For given j=1, . . . ,m make x_{ij}, i=1, . . . ,n_j be independent log-life variates which are ψ-normal with mean ν_j but common shape parameter α. In order to eliminate the different location parameters, consider the statistic

$$y_{ij} = \sqrt{n_j/(n_j - 1)}\, x_{ij} - x_{\cdot j}), \qquad i=1, \ldots, n_j, \qquad j=1, \ldots, m$$

where the dot indicates the index being averaged over. Note that $y_{\cdot j} = 0$ and consider the sample variances

$$s_{yj}^2 = \frac{1}{n_j} \sum_{i=1}^{n_j} (y_{ij} - y_{\cdot j})^2 = \sum_{i=1}^{n_j} \frac{(x_{ij} - x_{\cdot j})^2}{n_j - 1}$$

$$s_{xj}^2 = \frac{1}{n_j} \sum_{i=1}^{n_j} (x_{ij} - x_{\cdot j})^2 = \frac{n_j - 1}{n_j} s_{yj}^2$$

From the preceding lemma it follows that $Es_{yj}^2 = \sigma^2$ and hence

$$Es_{xj}^2 = (n_j - 1)\sigma^2/n_j.$$

Suppose that ψ is the identity function, i.e., fatigue life is log-normal, then

$$\mathrm{var}(s_{yj}^2) = \mathrm{var}\, \frac{\sigma^2}{n_j - 1} \sum_{j=1}^{n_j} \left(\frac{x_{ij} - x_{\cdot j}}{\sigma}\right)^2 = \mathrm{var}\left(\frac{\sigma^2}{n_j - 1} \chi^2_{\, n_j - 1}\right)$$

$$= \frac{\sigma^4 2(n_j - 1)}{(n_j - 1)^2} = \frac{2\sigma^4}{n_j - 1}.$$

Here use has been made of the fact that the squared deviation from the sample mean of n_j standard normal variates has a chi-square distribution with $(n_j - 1)$ degrees of freedom. It is also recalled that the variance of a chi-square variate is twice the number of degrees of freedom.

Therefore, in the case where fatigue life is log-normal, to obtain a minimum variance unbiased estimate of σ^2 using s_{yj}^2, merely form

$$\tilde{\sigma}^2 = \frac{\sum_{j=1}^{m} (n_j - 1)s_{yj}^2}{\sum_{j=1}^{m} (n_j - 1)} = \frac{\sum_{j=1}^{m} n_j s_{xj}^2}{\sum_{j=1}^{m} (n_j - 1)} .$$

As a check that the estimate obtained is as claimed, form another estimate by putting all y_{ij} together to form

$$s_y^2 = (\sum_{ij} y_{ij} - \bar{y})/\Sigma n_j$$

where $\bar{y} = \sum_{ij} y_{ij}/\Sigma n_j = \sum_{j} n_j y_{.j} = 0$. Now

$$s_y^2 = \sum_{ij} y_{ij}^2 / \sum_{j} n_j = \sum_{j=1}^{m} \sum_{i=1}^{n_j} \frac{n_j}{n_j - 1} (x_{ij} - x_{.j})^2 / \sum_{j=1}^{m} n_j$$

$$= \sum_{j=1}^{m} \frac{n_j^2 s_{xj}^2}{n_j - 1} / \sum_{j=1}^{m} n_j .$$

Note that $Es_y^2 = \sigma^2$. Hence this is also an unbiased estimate of σ^2, but since

$$\text{var}(s_y^2) = \sum_{j=1}^{m} \left(\frac{n_j^2}{n_j - 1}\right)^2 \text{var}\, s_{xj}^2 / (\Sigma n_j)^2$$

$$= 2\sigma^4 \sum_{j=1}^{m} \frac{n_j^2}{n_j - 1} / (\sum_{j=1}^{m} n_j)^2$$

it is claimed that $\text{var}(\tilde{\sigma}^2) < \text{var}(s_y^2)$ since

$$\frac{1}{\sum_{j=1}^{m} (n_j - 1)} < \sum_{j=1}^{m} \frac{n_j^2}{n_j - 1} / (\Sigma n_j)^2$$

which can be seen by cross-multiplication and applying Schwarz's inequality.

APPENDIX II

LISTED VALUES OF FATIGUE-LIFE OBSERVATIONS FOR ALL COLLECTED DATA (INCLUDING SOURCES)

TABULATED RESULTS

This appendix tabulates the item number, data reference, data description, and all the individual observations from the collected fatigue data. The individual observation is categorized as either a failed or a suspended item. Also listed on the output are the test sample size, the number of failed items, and the number of suspended items. A 13-digit description code (see below) is provided to catalog the variables of melting process, strength range, specimen thickness, material, grain direction, type of structure, type of specimen, finish, type of loading, and testing peculiarities.

The selection of reference numbers for the data sources is to some extent arbitrary. They have been arranged so as to allow the addition of new sources to the data bank. Reference numbers 200-300 have been reserved for titanium sources and 301-399 for steel sources. Reference numbers 1-199 were selected earlier for a data bank on aluminum alloy and reported elsewhere (reference 1).

Finally, a complete listing of the data references is presented, and corresponds with the REF column of the computer printout.

DESCRIPTION CODE

Column Number	Variable Description
1	melting process
2	strength range
3 - 5	specimen thickness
6 - 7	material
8	grain direction
9	type of structure
10	type of specimen
11	finish
12	type of loading
13	test peculiarities

Possible Inputs for Description Code

Column 1—melting process

0 unknown
1 air melted
2 vacuum melted

Column 2–strength range

0 unknown
1 0 to 100 ksi
2 101 to 160 ksi
3 161 to 200 ksi
4 201 to 240 ksi
5 241 to 280 ksi
6 281 to 320 ksi
7 321 to 380 ksi

Columns 3-5–specimen thickness (thickness of minimum or fractured material or specimen diameter (10^{-3} inches))

000 thickness not known or variable

Columns 6-7–materials

01 2024-T3 bare
02 2024-T3 clad
03 2024-T3 EXTR
04 2024-T4 bare
05 2024-T4 clad
06 2024-T4 EXTR
07 none assigned
08 6061-T6
09 none assigned
10 7075-T6 bare
11 7075-T6 clad
12 7075-T6 EXTR
13 7075-T6 die-forged
14 7076-T6 bare
15 7076-T6 clad
16 7076-T6 EXTR
17 7079-T6 bare
18 7079-T6 clad
19 7079-T6 EXTR
20 7178-T6 bare
21 7178-T6 clad
22 7178-T6 EXTR
23 7076-T61
24 AlSl-301
25 A286 (fastener steel)
26 general steels (others)
27 DTD 687A Al alloy
28 2024-0 (annealed)
29 1100
30 DTD 363A
31 DTD 364B EXTR
32 DTD 683 (RR. 77) EXTR
33 DTD 546B clad

Columns 6-7 (continued)

34 DTD 610 clad
35 normalized alloy steel (Swedish specification) < 100 ksi
36 AISI 4130
37 AISI 4330
38 AISI 4340
39 300M
40 D6A
41 5Cr-Mo-V (H11)
42 9Ni-4Co-0.20C
43 9Ni-4Co-0.25C
44 9Ni-4Co-0.30C
45 9Ni-4Co-0.45C
46 intermediate alloy steel (others)
47 Hastelloy X
48 Inconel X
49 Rene 41
50 superalloy steel (others)
51 2024 skin and 2024 stiffener
52 2024 skin and 2024 stiffener and other additional materials
53 2024 skin and 7075 stiffener
54 2024 skin and 7075 stiffener and other additional materials
55 7075 skin and 7075 stiffener
56 7075 skin and 7075 stiffener and other additional materials
57 none assigned
58 7178 skin and 7178 stiffener
59 7178 skin and 7178 stiffener and other additional materials
60 Ti alloy 6Al-4V mill annealed (condition 1) sheet
61 Ti alloy 6Al-4V mill annealed (condition 1) plate
62 Ti alloy 6Al-4V mill annealed (condition 1) extrusion
63 Ti alloy 6Al-4V mill annealed (condition 1) forging
64 Ti alloy 6Al-4V duplex annealed (condition V) sheet
65 Ti alloy 6Al-4V duplex annealed (condition V) plate
66 Ti alloy 6Al-4V solution treated and aged (condition III) sheet
67 Ti alloy 6Al-4V solution treated and aged (condition III) plate
68 Ti alloy 6Al-4V solution treated and aged (condition III) extrusion
69 Ti alloy 6Al-4V solution treated and aged (condition III) forging
70 Ti alloy 6Al-4V solution treated and overaged plate
71 Ti alloy 6Al-4V solution treated and overaged extrusion
72 Ti alloy 6Al-4V solution treated and overaged forging
73 Ti alloy 6Al-4V rolled sheet—continuously annealed
74 Ti alloy 8Al-1Mo-1V mill-annealed sheet
75 Ti alloy 8Al-1Mo-1V mill-annealed plate
76 Ti alloy 8Al-1Mo-1V mill-annealed extrusion
77 Ti alloy 8Al-1Mo-1V mill-annealed forging
78 Ti alloy 8Al-1Mo-1V duplex-annealed sheet
79 Ti alloy 8Al-1Mo-1V duplex-annealed plate
80 Ti alloy 8Al-1Mo-1V duplex-annealed extrusion

Columns 6-7 (continued)

81 Ti alloy 8Al-1Mo-1V duplex-annealed forging
82 Ti alloy 8Al-1Mo-1V triplex-annealed sheet
83 18% Ni maraging steel (200)
84 18% Ni maraging steel (250)
85 18% Ni maraging steel (300)
86 none assigned
87 2014-T6 hand-forged
88 7075-T6 hand-forged
89 7079-T6 hand-forged
90 AM 350
91 17-7 PH
92 PH 15-7 Mo
93 17-4 PH
94 AM 355
95 15-5 PH
96 PH B-8 Mo
97 custom 455 (fastener)
98 stainless steels (others)
99 alloy steels (others)

Column 8—grain direction

0 grain direction not known
1, 2, 3, 4, 5 } none assigned
6 diagonal
7 other directions
8 longitudinal
9 short transverse

Column 9—type of structure

0 lugs
1 butt joint
2 lap joint
3 double shear
4 scarf joint
5 monolithic unnotched
6 monolithic notched
7 partial load transfer
8 structural components and full-scale structures
9 service airplanes

Column 10–type of specimen

0 open holes
1 riveted
2 spotwelded
3 bolted
4 riveted and bonded
5 edge notched
6 pin connected
7 riveted and bolted
8 bonded
9 others

Column 11–finish

0 normal
1 shot peened
2 chemically milled
3 corroded
4 machine milled and polished
5 chemically milled and shot peened
6 chemically milled and polished
7 different etchants
8 others
9 heat treated

Column 12–type of loading

0 axial (comp-comp)
1 axial (other types)
2 bending flexural
3 bending rotating beam
4 torsion
5 spectrum (random)
6 spectrum (decreasing stress amplitude)
7 spectrum (increasing)
8 spectrum (up and down stress)
9 sonic fatigue

Column 13–test peculiarities

0 complete failure–test at room temperature
1 first crack–test at room temperature
2 none assigned
3 none assigned
4 first crack–test with temperature cycles also
5 none assigned
6 complete failure–test at elevated temperature
7 first crack–test at elevated temperature
8 complete failure–test at lowered temperature
9 first crack–test at lowered temperature

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
10001	200	0006366860010	0	60000	F	2300	12875			
10002	200	0006366860010	0	50000	F	34000	41000	48000		
10003	200	0006366860010	0	40000	F	84000	88000	147000		
10004	200	0006366860010	0	35000	F	181000	314000	353000		
10005	200	0006366860010	0	30000	F	144000	1362000	1709000		
10006	200	0006366860016	0	40000	F	49000	57000	58000		
10007	200	0006366860016	0	35000	F	92000	113000	131000		
10008	200	0006366860016	0	30000	F	129000	181000	273000		
10009	200	0006366860016	0	27500	F	10000000	948000			
					S	10000000				
10010	200	0006366860016	0	100000	F	95	439			
10011	200	0006366860016	0	35000	F	50000	57000	72000		
10012	200	0006366860016	0	30000	F	220000	224000	349000		
10013	200	0006366860016	0	27500	F	134000	569000	598000		
10014	200	0006366860016	0	30000	F	55000	70000			
10015	200	0006366860016	0	25000	F	148000	155000	487000		
10016	200	0006366860016	0	24000	F	145000	383000	716000		
10017	200	0006366860016	0	30000	F	68000	70000	84000		
10018	200	0006366860016	0	25000	F	225000	693000	7052000		
10019	200	0006366860010	35000	35000	F	33000	37000	41000		
10020	200	0006366860010	25000	25000	F	55000	79000	141000		
10021	200	0006366860010	22500	22500	F	141000	170000	2936000		
10022	200	0006366860016	25000	25000	F	66000	80000	102000		
10023	200	0006366860016	22500	22500	F	94000	119000	150000		
10024	200	0006366860016	21250	21250	F	108000	111000	174000		
10025	200	0006366860016	25000	25000	F	38000	38000	57000		
10027	200	0006366860016	20000	20000	F	121000	135000	157000	2602000	
10026	200	0006366860016	21250	21250	F	75000	1950000	2552000		
10028	200	0006366860016	18750	18750	F	10000000	760000	1500000		
					S	10000000				
10029	200	0006366860016	22500	22500	F	63000	91000	202000		
10030	200	0006366860016	21250	21250	F	38000	41000	269000		
10031	200	0006366860016	20000	20000	F	10000000	10000000	169000	366000	432000
					S	10000000	10000000			
10032	200	0006366860016	22500	22500	F	38000	80000	660000		
10033	200	0006366860016	20000	20000	F	176000	660000	3027000		
10034	200	0006366860010	61520	18480	F	73000	81000	126000		
10035	200	0006366860010	57675	17325	F	72000	148000	195000		
10036	200	0006366860010	53830	16170	F	187000	248000	2628000		
10037	200	0006366860016	61520	18480	F	49000	62000	80000		
10038	200	0006366860016	53830	16170	F	83000	116000	625000		

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)		
10039	200	0006366860016	51910	15590	F	99000	187000	970000
10040	200	0006366860016	61520	18480	F	37000	57000	58000
10041	200	0006366860016	53830	16170	F	86000	94000	240000
10042	200	0006366860016	51910	15590	F	10000000	611000	850000
					S	10000000		
10043	200	0006366860016	53830	16170	F	42000	110000	298000
10044	200	0006366860016	49985	15015	F	78000	455000	1628000
10045	200	0006366860016	46160	13860	F	414000	1252000	1380000
10046	200	0006366860016	53830	16170	F	55000	56000	68000
10047	200	0006366860016	46160	13860	F	497000	620000	666000
10048	200	0006366860016	42295	12705	F	1237000	2401000	
10049	200	0006366860016	38450	11550	F	1210000	2387000	2785000
10050	200	0012566860010	0	45000	F	108000	108000	219000
10051	200	0012566860010	0	40000	F	124000	129000	264000
10052	200	0012566860010	0	37500	F	220000	392000	936000
10053	200	0012566860016	0	45000	F	47000	51000	67000
10054	200	0012566860016	0	40000	F	81000	100000	222000
10055	200	0012566860016	0	35000	F	156000	191000	271000
10056	200	0012566860016	0	30000	F	552000	1640000	2550000
10057	200	0012566860016	0	40000	F	51000	64000	87000
10058	200	0012566860016	0	35000	F	72000	216000	337000
10059	200	0012566860016	0	30000	F	334000	2970000	3442000
10060	200	0012566860016	0	35000	F	65000	77000	119000
10061	200	0012566860016	0	30000	F	100000	105000	332000
10062	200	0012566860016	0	25000	F	210000	312000	358000
10063	200	0012566860016	0	35000	F	43000	63000	
10064	200	0012566860016	0	30000	F	105000	159000	172000
10065	200	0012566860016	0	25000	F	185000	2826000	
10066	200	0012566860010	32500	32500	F	36000	48000	63000
10067	200	0012566860010	27500	27500	F	75000	126000	
10068	200	0012566860010	22500	22500	F	233000	481000	5121000
10069	200	0012566860016	27500	27500	F	48000	65000	104000
10070	200	0012566860016	22500	22500	F	46000	125000	
10071	200	0012566860016	20000	20000	F	10000000	195000	
					S	10000000		
10072	200	0012566860016	18750	18750	F	228000	290000	1878000
10073	200	0012566860016	27500	27500	F	60000	69000	
10074	200	0012566860016	22500	22500	F	112000	118000	124000
10075	200	0012566860016	20000	20000	F	10000000	10000000	
					S	10000000	10000000	
10076	200	0012566860016	17500	17500	F	1870000	2820000	5358000

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
10077	200	0012566860016	25000	25000	F	86000	191000	201000		
10078	200	0012566860016	22500	22500	F	113000	133000	311000		
10079	200	0012566860016	20000	20000	F	212000	451000	1069000		
10080	200	0012566860016	22500	22500	F	51000	62000	67000		
10081	200	0012566860016	20000	20000	F	261000	284000	2583000		
10082	200	0012566860016	17500	17500	F	10000000	1282000			
					S	10000000				
10083	200	0012566860010	69210	20790	F	30000	87000	98000		
10084	200	0012566860010	61520	18480	F	84000	84000	162000		
10085	200	0012566860010	53830	16170	F	142000	336000	443000		
10086	200	0012566860010	46140	13860	F	586000	1669000	3340000		
10087	200	0012566860016	61520	18480	F	78000	88000	117000		
10088	200	0012566860016	53830	16170	F	70000	81000	178000		
10089	200	0012566860016	49985	15015	F	121000	152000	1718000		
10090	200	0012566860016	46140	13860	F	1137000	1449000	6837000		
10091	200	0012566860016	61520	18480	F	49000	76000	136000		
10092	200	0012566860016	53830	16170	F	209000	540000	568000		
10093	200	0012566860016	46140	13860	F	124000	710000	4188000		
10094	200	0012566860016	42295	12705	F	198000	3440000	7738000		
10095	200	0012566860016	57675	17325	F	59000	160000	184000		
10096	200	0012566860016	53830	16170	F	66000	97000	415000		
10097	200	0012566860016	49985	15015	F	2000000	2008000	3744000		
10098	200	0012566860016	46140	13860	F	117000	329000	2645000		
10099	200	0012566860016	57675	17325	F	48000	50000	59000		
10100	200	0012566860016	53830	16170	F	67000	175000	274000	479000	
10101	200	0012566860016	46140	13860	F	636000	792000	3339000		
10102	200	0012566860016	42295	12705	F	1484000	1526000	6513000		
10103	201	0002560812011	49100	49100	F	400	300	450	350	395
10104	201	0002560812010	49100	49100	F	675	792	892	1003	837
10105	201	0002560812011	55500	55500	F	250	300	265	310	230
10106	201	0002560812010	55500	55500	F	334	549	451	448	316
10107	201	0002560812011	62000	62000	F	150	115	170	125	168
10108	201	0002560812010	62000	62000	F	152	214	191	196	263
10109	201	0002560912011	58000	58000	F	450	450	350	500	550
10110	201	0002560912010	58000	58000	F	629	564	546	722	1033
10111	201	0002560812018	76500	76500	F	80	73	80	85	
10112	201	0002560812018	86500	86500	F	30	5	1	2	8
10113	201	0002560812018	90000	90000	F	5	41	6	4	2
10114	201	0002560812018	67000	67000	F	37	58	55	46	37
10115	201	0002560812018	76000	76000	F	4	8	2	11	
10116	201	0002560912018	72500	72500	F	42	10	9	27	5

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
10117	202	0003666865010	43750	26250	F	12000	12001			
10118	202	0003666865010	37500	22500	F	11000	14000			
10119	202	0003666865010	31250	18750	F	20000	44000			
10120	202	0003666865010	25000	15000	F	149000	1810000			
10121	202	0003666965010	43750	26250	F	8000	9000			
10122	202	0003666965010	37500	22500	F	12000	12001			
10123	202	0003666965010	31250	18750	F	44000	52000	000		
10124	203	0006566865010	28800	17800	F	356000	289000			
10125	203	0006566865010	25850	16950	F	186000	289000	432000	659000	
10126	203	0006566865010	26600	25900	F	26000	86000	27000		
10127	203	0006566865010	28800	60800	F	126000	332000	33000		
10128	204	0000066865010	25000	36000	F	22000	22000	36000		
10129	204	0000066865010	25000	25000	F	57000	85000	26000		
10130	204	0000066865010	25000	25000	F	33000	184000	1334000		
10131	204	0000066865010	25000	36000	F	69000	97000	192000	152000	315000
10132	204	0000066865010	25000	43000	F	54000	68000	75000	620000	
10133	204	0000066865010	25000	42000	F	683000	3899000	2212000		
10134	204	0000066865010	25000	43000	F	86000	1685000	2805000		
10135	204	0000066865010	25000	39000	F	10568000	2305000	2768000		
10175	204	0000074819010	25000	37000	S	18896000	5066000	5985000	6588000	
10136	204	0000066812010	25000	25000	F	10021000	5328000	28000		
10137	204	0000060812010	25000	20000	S	10058000	35000	51000	58000	
10138	204	0000066812010	25000	35000	F	4949000	5672000	8586000	132000	133000
10139	204	0000060812810	25000	12000	F	99000	126000	175000	138000	51000
10179	204	0000060812810	25000	15000	F	338000	436000	582000	45000	1255000
10168	204	0000060819810	25000	65000	F	39000	86000	82000	48000	67000
10142	204	0000060812810	25000	66000	F	128000	122000	183000	189000	229000
10143	204	0000060819810	25000	55000	F	126000	156000	286000	225000	261000
10144	204	0000060819810	25000	56000	F	88000	185000	128000	157000	189000
10145	204	0000060819810	25000	45000	F	61000	56000	183000	289000	533000
10146	204	0000060819810	25000	48000	F	583000	1453000	3293000	107000	228000
10166	204	0000066865810	25000	48000	F	10068000	1026000	7328000	48000	56000
10187	204	0000074865810	25000	15000	S	10058000	40000	59000	493000	59000
10188	204	0000066865810	25000	36000	F	456000	1065000	56000	60000	43000
10189	204	0000074865810	25000	25000	F	125000	149000	186000	290000	575000
10190	204	0000074865810	25000	22000	F	159000	186000	284000	208000	217000
10191	204	0000074865810	25000	25000	F	126000	156000	229000	503000	559000
10192	204	0000074865810	25000	38000	F	42000	67000	89000	156000	323000
10193	204	0000074819810	25000	50000	F	47000	74000	115000	116000	156000
10194	205	0005078860010	-15000	60000	F	3320	3400	3430		
10195	205	0005078860010	-15000	50000	F	9020	9410	9560		

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	STRESSES ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
10196	205	0005078860010	-15000	40000	F	28000	28000	33000				
10197	205	0005078860010	-15000	30000	F	171000	237000	248000				
10198	205	0005078860010	-15000	28000	F	425000	581000	942000				
10199	205	0005078860010	-15000	27000	F	448000	703000	896000				
10200	205	0005078860010	0	60000	F	1510	1730	2000				
10201	205	0005078860010	0	50000	F	4330	4400	4560				
10202	205	0005078860010	0	40000	F	13000	13020	13340	14430			
10203	205	0005078860010	0	30000	F	36000	50000	54000	54000	65000		
10204	205	0005078860010	0	25000	F	147000	175000	243000	451000	681000		
10205	205	0005078860010	0	20000	F	10000000	3882000	7588000	7808000			
					S	10000000						
10206	205	0005078860010	25000	55000	F	1360	1370					
10207	205	0005078860010	25000	45000	F	3340	3700					
10208	205	0005078860010	25000	35000	F	9690	9750					
10209	205	0005078860010	25000	30000	F	15000	18000	20000				
10210	205	0005078860010	25000	25000	F	24320	28000	28820	30000	34430	39000	
10211	205	0005078860010	25000	19000	F	33000	48000	54000				
10212	205	0005078860010	25000	15000	F	61000	185000	2541000				
10213	205	0005078860010	25000	11000	F	136000	205000	5284000				
10214	205	0005078860010	50000	30000	F	5230	6660	7020				
10215	205	0005078860010	50000	25000	F	10580	11070	12970				
10216	205	0005078860010	50000	15000	F	37000	53000	59000				
10217	205	0005078860010	50000	10000	F	122000	186000	1246000				
10218	205	0005078860016	15000	55000	F	3230	3510					
10219	205	0005078860016	15000	45000	F	11040	12100	25640				
10220	205	0005078860016	15000	35000	F	42000	46000	47000				
10221	205	0005078860016	15000	25000	F	573000	587000	3392000				
10222	205	0005078860016	0	50000	F	2870	2900	3080				
10223	205	0005078860016	0	40000	F	10010	19490	28930				
10224	205	0005078860016	0	30000	F	29000	29000	31000				
10225	205	0005078860016	0	25000	F	77000	215000	795000				
10226	205	0005078860016	0	20000	F	1153000	2363000	2800000				
10227	205	0005078860016	25000	50000	F	1340	1360	1480				
10228	205	0005078860016	25000	45000	F	2430	2450	2510	2630	2730		
10229	205	0005078860016	25000	40000	F	3690	3900	4140	4180	4290		
10230	205	0005078860016	25000	35000	F	6860	7050	7150	7420	7690		
10231	205	0005078860016	25000	30000	F	8000	11270	11510	12740			
10232	205	0005078860016	25000	25000	F	18000	18000	18000	20620	22180	24750	27000
10233	205	0005078860016	25000	20000	F	36000	312000	316000	577000			
10234	205	0005078860016	25000	15000	F	62000	979000	2012000	2513000			
10235	205	0005078860016	50000	25000	F	7000	8000	9000				

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
10236	205	0005078860016	50000	15000	F	53000	60000	522000				
10237	205	0005078860016	50000	10000	F	2784000	2912000	2977000				
10238	205	0005078860080	VARIABLE AMP. LOADS		F	13400	33300	16600	14800	13900	17560	12774
10239	205	0005078860080	VARIABLE AMP. LOADS		F	7850	7270	6420	7520	7950	8300	6540
					F	7070	5800					
10240	205	0005078860080	VARIABLE AMP. LOADS		F	52000	46600					
					S	52000						
10241	205	0005078860080	VARIABLE AMP. LOADS		F	16100	15000	13500				
10242	205	0005078860080	VARIABLE AMP. LOADS		F	7800	6600	6700				
10243	205	0005078860080	VARIABLE AMP. LOADS		F	40940	26700	17700				
10244	205	0005078860080	VARIABLE AMP. LOADS		F	11600	8950	8450				
10245	205	0005078860080	VARIABLE AMP. LOADS		F	5650	5150	5920				
10246	205	0005078860080	VARIABLE AMP. LOADS		F	52000	12300	8250	13200			
					S	52000						
10247	205	0005078860080	VARIABLE AMP. LOADS		F	5250	6450	7070				
10248	205	0005078860080	VARIABLE AMP. LOADS		F	7100	7300	12800	9400	7100		
10249	205	0005078860086	VARIABLE AMP. LOADS		F	52000	17680	34040	42700	32500		
					S	52000						
10250	205	0005078860086	VARIABLE AMP. LOADS		F	7130	6900	7554	6448			
10251	205	0005078860086	VARIABLE AMP. LOADS		F	4350	4110	3900				
10252	205	0005078860086	VARIABLE AMP. LOADS		F	14000	16100	19900				
10253	205	0005078860086	VARIABLE AMP. LOADS		F	6150	7750	5850				
10254	205	0005078860086	VARIABLE AMP. LOADS		F	3680	2920	3350				
10255	205	0005078860086	VARIABLE AMP. LOADS		F	19600	18100	19200				
10256	205	0005078860086	VARIABLE AMP. LOADS		F	6420	5500	5300				
10257	205	0005078860086	VARIABLE AMP. LOADS		F	3450	2800	2410				
10258	205	0005078860086	VARIABLE AMP. LOADS		F	52000	17800					
					S	52000						
10259	205	0005078860086	VARIABLE AMP. LOADS		F	6350	7750	6240				
10260	205	0005078860086	VARIABLE AMP. LOADS		F	2640	3260	3460				
10261	205	0005078860086	VARIABLE AMP. LOADS		F	52000	28000					
					S	52000						
10262	205	0005078860086	VARIABLE AMP. LOADS		F	3760	4100	5850				
10263	206	0005074960081	VARIABLE AMP. LOADS		F	35300	41800	49700	68500			
10264	206	0005074960087	VARIABLE AMP. LOADS		F	27000	28600	19600	33400			
10265	206	0005074960084	VARIABLE AMP. LOADS		F	60900	68240	52000	59000			
10266	206	0005078960081	VARIABLE AMP. LOADS		F	26500	29500	41000	48000	54340	56000	57000
					F	69000	75900	82000	105000			
10267	206	0005078960087	VARIABLE AMP. LOADS		F	15100	23500	25000	25000			
10268	206	0005078960087	VARIABLE AMP. LOADS		F	15900	15900	18400	18600			
10269	206	0005078960084	VARIABLE AMP. LOADS		F	41900	59100	64800				

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
10270	206	0005078972081	VARIABLE AMP. LOADS		F	29000	30000	38000	41400			
10271	206	0005078972087	VARIABLE AMP. LOADS		F	17400	18200	19000	20400			
10272	206	0005078972087	VARIABLE AMP. LOADS		F	13600	14000	14000	15000			
10273	206	0005078972084	VARIABLE AMP. LOADS		F	69000	43500	45000				
					S	69000						
10274	206	0005078972084	VARIABLE AMP. LOADS		F	28900	29400	37400	49250			
10275	206	0005082960081	VARIABLE AMP. LOADS		F	80000	80000					
					S	80000	80000					
10276	206	0005082960087	VARIABLE AMP. LOADS		F	15000	26500	32000	77500			
10277	206	0005082960084	VARIABLE AMP. LOADS		F	79900	80000					
10278	206	0005060960081	VARIABLE AMP. LOADS		F	32000	39000	21000	24500			
10279	206	0005060960087	VARIABLE AMP. LOADS		F	11000	13000	23000	23400			
10280	206	0005060960084	VARIABLE AMP. LOADS		F	18200	18200	18200	23400			
10281	206	0005075860081	VARIABLE AMP. LOADS		F	80000	46000	73000				
					S	80000						
10282	206	0005076860087	VARIABLE AMP. LOADS		F	12000	16500	11800	15700			
10283	206	0005076860084	VARIABLE AMP. LOADS		F	67000	73700					
10284	206	0005068860081	VARIABLE AMP. LOADS		F	82000	82000					
					S	82000	82000					
10285	206	0005068860087	VARIABLE AMP. LOADS		F	15000	17000	23500	24400			
10286	206	0005068860084	VARIABLE AMP. LOADS		F	26200	35200	29500	34000			
10287	206	0005082960081	VARIABLE AMP. LOADS		F	26800	36000	26700	37200			
10288	206	0005082960087	VARIABLE AMP. LOADS		F	14800	21000	14600	15000			
10289	206	0005082960084	VARIABLE AMP. LOADS		F	19700	20000	27500	50000			
10290	206	0005076860081	VARIABLE AMP. LOADS		F	80000	42800	65100				
					S	80000						
10291	206	0005076860087	VARIABLE AMP. LOADS		F	11000	14000	14000	17000			
10292	206	0005076860084	VARIABLE AMP. LOADS		F	34200	71000	21000	34500			
10293	206	0005071860081	VARIABLE AMP. LOADS		F	10000	10000	10200	11500	12000	16700	17000
					F	20000						
10294	206	0005071860087	VARIABLE AMP. LOADS		F	8000	8500	7000	11000			
10295	209	0004482865018	25000	20000	F	54000	73000					
10296	209	0004482965018	25000	25000	F	47500	36000					
10297	209	0004482865018	25000	17500	F	139000	192000					
10298	209	0004482865010	0	22000	F	99500	156300					
10299	209	0004482865010	25000	14000	F	68000	83500					
10300	209	0004482865010	60000	10000	F	103400	109600					
10301	210	0005078960010	23000	19000	F	97560	85140	189900				
10302	210	0005078960010	23000	19000	F	64260	40140	69480				
10303	210	0005078960016	23000	19000	F	50220	60120	88740				
10304	210	0005078960016	23000	19000	F	54180	55080	55800				

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
10305	210	0005078960016	23000	19000	F	35100	34560	26820				
10306	210	0005078960016	23000	19000	F	1800000	50760					
					S	1800000						
10307	210	0005078919010	55000	45000	F	140400	147240	66290				
10308	210	0005078960081	VARIABLE AMP. LOADS		F	76000	34377	43106				
					S	76000						
10309	210	0005078972081	VARIABLE AMP. LOADS		F	3000	3001					
10310	210	0005078960081	VARIABLE AMP. LOADS		F	26500	29500	54340	56000	57000	83000	105000
					F	75900						
10311	210	0005078972081	VARIABLE AMP. LOADS		F	6000	9400					
10313	210	0005078960087	VARIABLE AMP. LOADS		F	15900	15901	18400	18600			
10315	210	0005078960084	VARIABLE AMP. LOADS		F	41900	59100	64800				
10317	210	0005078960014	35000	35000	F	7750	7841					
10318	210	0005078960014	30000	30000	F	36527	43098					
10319	210	0005078960014	32500	32500	F	6662	8262					
10320	210	0005078919014	44000	44000	F	19605	20000					
10321	210	0005078919014	47500	47500	F	16824	27374					
10322	210	0005078960316	27500	22500	F	12780	16740	12600				
10323	210	0005078960316	27500	22500	F	43200	26640	236340				
10325	210	0005078919316	44000	36000	F	38340	9900	25560				
10326	210	0005078919316	44000	36000	F	17100	77400	17640				
10327	210	0005078960316	27500	22500	F	78660	305460	148500				
10328	210	0005078919316	44000	36000	F	1000000	39240					
					S	1000000						
10329	210	0005078960316	27500	22500	F	235620	179100	426780				
10330	210	0005078919316	44000	36000	F	1000000	27720					
					S	1000000						
10331	210	0005078960316	27500	22500	F	109620	356580	267480				
10333	210	0005078919316	44000	36000	F	53820	773100	105920				
10334	210	0005078960316	27500	22500	F	25740	24120	21060				
10335	210	0005078960316	27500	22500	F	748800	362700					
10336	210	0005078960387	VARIABLE AMP. LOADS		F	17200	17600					
10337	210	0005078960387	VARIABLE AMP. LOADS		F	17250	17251					
10342	211	0003666865810	56000	14000	F	12000	12100					
10343	211	0003666865810	48000	12000	F	11000	14000					
10344	211	0003666865810	40000	10000	F	20000	44000					
10345	211	0003666865810	32000	8000	F	149000	1810000					
10346	211	0003666965810	56000	14000	F	8000	9000					
10347	211	0003666965810	48000	12000	F	12000	12100					
10348	211	0003666965810	40000	10000	F	52000	44000					
10349	212	0012574873010	31800	28200	F	112120	129420	96010				

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)		
10350	212	0012564873010	31800	28200	F	42010	59070	
10351	212	0012564873010	31800	28200	F	52100	48790	
10352	212	0012564873010	21200	18800	F	328370	231730	
10353	212	0012574873016	31800	28200	F	39910	38800	
10354	212	0012578873010	31800	28200	F	57440	57210	55640
10355	212	0012574873010	31800	28200	F	108480	121780	
10356	212	0012574972010	31800	28200	F	79620	78670	
10357	212	0012574872016	31800	28200	F	60910	64710	70820
10358	212	0012574872010	21200	18800	F	4043260	448120	
10359	212	0012574872016	21200	18800	F	240710	202230	
10360	212	0012574972010	5000	35000	F	63400	54820	
10361	212	0012574872010	7500	52500	F	19520	17420	
10362	212	0012574872010	3750	26250	F	162690	159400	
10363	212	0012574872010	31800	28200	F	149350	117650	
10364	213	0005082860010	25000	50000	F	9000	10000	
10365	213	0005082860010	25000	25000	F	115000	124000	
10366	213	0005082860016	25000	25000	F	477000	37000	
					S	477000		
10367	213	0005082860016	25000	50000	F	5000	6000	
10368	213	0005082860016	25000	37500	F	6000	14000	
10369	213	0005082860016	25000	50000	F	3000	4500	
10370	213	0005082819010	25000	50000	F	48000	274000	
10371	213	0005082819010	25000	62500	F	25000	37000	
10372	213	0005082819016	25000	62500	F	3000	6000	
10373	213	0005082819016	25000	50000	F	30000	67000	
10374	213	0005082819016	25000	50000	F	4000	20000	
10375	213	0005082819016	25000	62500	F	1000	1001	
10376	213	0005082819016	25000	37500	F	13000	37000	
10377	213	0005082819010	25000	25000	F	222000	2808000	
10378	213	0005082819010	25000	50000	F	23000	32000	
10379	213	0005082819010	25000	62500	F	6000	32000	
10380	213	0005082819016	25000	25000	F	60000	101000	
10381	213	0005082819016	25000	50000	F	3000	5000	
10382	213	0005082819016	25000	25000	F	35000	104000	
10383	213	0005082819016	25000	50000	F	8000	15000	
10384	213	0005082872010	25000	50000	F	6000	12000	
10385	213	0005082872010	25000	25000	F	107000	127000	
10386	213	0005082872010	25000	62500	F	5000	8000	
10387	213	0005082872016	25000	25000	F	38000	83000	
10388	213	0005082872016	25000	50000	F	200	1000	2000
10389	213	0005082872016	25000	12500	F	163000	4532000	

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)		
10390	213	0005082872016	25000	50000	F	1000	8000	8000
10391	213	0005082872016	25000	25000	F	29000	32000	
10392	213	0005082823010	25000	50000	F	1000	2000	
10393	213	0005082823010	25000	25000	F	104000	131000	
10394	213	0005082823010	25000	12500	F	990000	1322000	
10395	213	0005082823016	25000	37500	F	4000	5000	
10396	213	0005082823016	25000	25000	F	9000	93000	
10397	213	0005082823016	25000	12500	F	164000	430000	
10398	213	0005082823016	25000	37500	F	1000	2000	
10399	213	0005082823016	25000	25000	F	18000	38000	
10400	213	0005082872016	25000	12500	F	145000	5095000	
10401	214	0004482865010	25000	14000	F	68000	83500	
10402	214	0004482865018	25000	20000	F	54000	73000	
10403	215	0006066022010	2500	1500	F	1048600	1868800	5913800
10404	216	0009078813010	26500	23500	F	206000	246000	
10405	216	0009078813010	31800	28200	F	69000	79000	
10406	216	0009078813010	37100	32900	F	35000	47000	
10407	216	0009078813010	26500	23500	F	116000	328000	
10408	216	0009078811010	26500	23500	F	35000	40000	
10409	216	0009078813010	31800	28200	F	77000	148000	
					S	77000		
10410	216	0009078813010	37100	32900	F	54000	83000	
10411	216	0004078822916	34450	30550	F	4000	40100	
10412	216	0004078822916	26500	23500	F	6000	7500	
10413	216	0004078822916	18550	16450	F	21000	22000	
10414	216	0004078822910	21200	18800	F	18000	18100	
10415	216	0004078822916	37100	32900	F	3000	3100	
10416	216	0004078822916	29150	25850	F	5000	5100	
10417	216	0004078822916	21200	18800	F	11000	13000	
10418	216	0004078822910	21200	18800	F	23000	24000	
10419	216	0006078822010	21200	18800	F	12000	14000	
10420	216	0006078872010	31800	28200	F	370000	421000	
10421	216	0025078872210	31800	28200	F	194770	198560	
10422	216	0006378872010	31800	28200	F	211000	322000	
10423	216	0006378872010	26500	23500	F	109000	307000	
10424	216	0009078833010	31800	28200	F	30000	41000	
10425	216	0003078871010	31800	28200	F	44000	75000	85000
10426	216	0006078871010	31800	28200	F	200000	295000	
10427	216	0009078872010	35510	31490	F	119000	294000	
10428	216	0009078872010	31800	28200	F	185000	204000	
10429	216	0009078872010	31800	28200	F	129000	244000	

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
10430	216	0009078871010	31800	28200	F	31000	41000			
10431	216	0025079860810	18550	16450	F	156000	179000			
10432	216	0009078872010	31800	28200	F	138700	156000	158000		
10433	216	0009078872010	31800	28200	F	81100	460800			
10434	216	0009078872010	31800	28200	F	74100	97100			
10435	216	0025075860810	21200	18800	F	259000	317000	508000		
10436	216	0025075860810	21200	18800	F	300000	309000			
10437	216	0025075860810	21200	18800	F	419000	2063000	2324000		
10438	216	0025075860810	21200	18800	F	165000	374000	536000		
10439	216	0025075860810	21200	18800	F	1046000	2213000	3866000		
10440	216	0025078872810	31800	28200	F	33340	34320	49020		
10441	216	0025078872810	31800	28200	F	28110	41340	46050		
10442	216	0025078872810	31800	28200	F	43660	48310			
10443	216	0025078872810	31800	28200	F	34000	37570			
10444	216	0025078872810	31800	28200	F	88020	153840	190220	192880	250100
10445	217	0002078829010	31800	28200	F	20000	21000			
10446	217	0002078829010	31800	28200	F	34000	47000			
10447	217	0004078822010	7950	7050	F	236000	239000			
10448	217	0004078822010	10600	9400	F	71000	85000			
10449	217	0004078822010	15900	14100	F	17000	23000			
10450	217	0004078822010	21200	18800	F	10000	14000			
10451	217	0006078822010	7950	7050	F	153000	172000			
10452	217	0006078822010	10600	9400	F	59000	106000			
10453	217	0006078822010	15900	14100	F	21000	30000			
10454	217	0006078822010	21200	18800	F	12000	15000			
10455	217	0009078822010	7950	7050	F	144000	148000			
10456	217	0009078822010	10600	9400	F	52000	56000			
10457	217	0009078822010	15900	14100	F	12000	13000			
10458	217	0004078822810	21200	18800	F	22000	23000			
10459	217	0004078822816	18550	16450	F	20000	53000			
10460	217	0004078822816	26500	23500	F	7000	7100			
10461	217	0004078822816	34550	30550	F	3000	4000			
10462	217	0004078822810	21200	18800	F	20000	34000			
10463	217	0004078822816	21200	18800	F	12000	15000			
10464	217	0004078822816	29150	25850	F	4000	4100			
10465	217	0004078822816	37100	32900	F	1000	1100			
10466	217	0004078822810	31800	28200	F	1000	5100			
					S	1000				
10467	217	0004078822810	26500	23500	F	1000	7000	7000		
					S	1000				
10468	217	0004078822810	18550	16450	F	16000	17000	28000		

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
10469	217	0004078822810	10600	9400	F	39000	58000	110000		
10470	217	0004078822810	18550	16450	F	18000	20000			
10471	217	0004078822810	37100	32900	F	3000	3000	3500		
10472	217	0004078822810	13250	11750	F	36000	48000	58000		
10473	217	0004078822816	26500	23500	F	6000	7000	7000		
10474	217	0004078822816	18550	16450	F	14000	15000	18000		
10475	217	0004078822816	34450	30550	F	3000	4000			
10476	217	0004078822816	13250	11750	F	34000	42000			
10477	217	0004078822816	26500	23500	F	5000	6000	7000		
10478	217	0004078822816	18550	16450	F	12000	14000	18000		
10479	217	0004078822816	34450	30550	F	3000	4000			
10480	217	0004078822816	13250	11750	F	26000	29000			
10481	217	0012574873010	5000	35000	F	146350	158810			
10482	217	0012574873010	6250	43750	F	53540	61140			
10483	217	0012574873010	4375	30625	F	209150	262330			
10484	217	0012574873010	3750	26250	F	487950	504960			
10485	217	0012574873010	3125	21875	F	816830	1189490			
10486	217	0012574873010	7500	52500	F	15500	15680			
10487	217	0012574873010	2500	17500	F	*6109000.	4585770			
10488	217	0012574873010	31800	28200	F	67030	73090	103360		
10489	217	0012574873010	21200	18800	F	267240	337530	477530		
10490	217	0012574873010	42400	37600	F	24000	25690			
10491	217	0012574873010	18550	16450	F	9185460	4285520			
					S	9185460				
10492	217	0012574873010	31500	13500	F	584310	808870	1651000		
10493	217	0012574873010	43050	18450	F	201330	202340	307730		
10494	217	0012574873010	35000	15000	F	486670	524840	525700		
10495	217	0012574873010	56000	24000	F	62470	69350			
10496	217	0012574873010	70000	30000	F	32830	34620			
10497	217	0012574879010	31800	28200	F	103940	242720	270260		
10498	217	0012574872010	31800	28200	F	64270	67740			
10499	217	0008560872010	31800	28200	F	64650	79560	83980	94810	104380
10341	217	0008560822010	31800	28200	F	2640	2760	2790		
10340	217	0008560822010	21200	18800	F	7630	8930			
10339	217	0008560829010	31800	28200	F	2160	3080			
10332	217	0008560829010	21200	18800	F	3090	4440			
10500	212	0012574872010	31800	28200	F	40150	26720			
10501	212	0012574871010	42400	37600	F	18240	17960			
10502	212	0012574861010	31800	28200	F	114000	246000	172000		
10503	212	0010078823010	26500	23500	F	19000	24000	18000		
10504	212	0010078823010	18550	16450	F	103000	86000	38000		

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
10505	212	0010078821010	18550	16450	F	158000	156000	126000	176000	213000	147000	
10506	212	0010078821010	21200	18800	F	101000	219000	151000				
10507	212	0010078821010	15900	14100	F	1759000	342000					
					S	1759000						
10508	212	0010078821010	15900	14100	F	652000	3672000	658000				
10509	212	0010078821010	21200	18800	F	141000	148000	361000				
10510	212	0010078823010	18550	16450	F	73000	47000	42000	63000	56000	46000	63000
					F	53000	34000					
10511	212	0010078821010	18550	16450	F	4000000	686000	292000	259000	510000	466000	473000
					F	224000	306000					
					S	4000000						
10512	212	0010060823010	26500	23500	F	43000	27000	31000	40000			
10513	212	0010060823010	26500	23500	F	23000	30000	25000	26000			
10514	212	0010060821010	26500	23500	F	10000	10000	11000	10000			
10515	212	0010060823010	21200	18800	F	67000	78000	76000	80000			
10516	212	0010060823010	21200	18800	F	48000	48000	62000	64000			
10517	212	0010060821010	21200	18800	F	26000	19000	23000	25000			
10518	212	0010060823010	15900	14100	F	131000	157000	114000	135000			
10519	212	0010060823010	15900	14100	F	174000	315000	193000	190000			
10520	212	0010060821010	15900	14100	F	96000	82000	126000	43000			
10521	212	0012574873010	31800	28200	F	11610	5650					
10522	212	0012574873010	10600	9400	F	126830	169640					
10523	212	0012574871010	31800	28200	F	18270	27610					
10524	212	0012574871010	10600	9400	F	575840	2775510					
10525	212	0025074872010	31800	28200	F	3400	2810					
10526	212	0012574861010	37100	32900	F	1021000	162000	111000	799000	144000		
10527	212	0012574861010	37100	32900	F	1535000	1750000	1252000	2030000	341000	852000	
10528	212	0012574860010	26500	23500	F	686000	680000	459000	63000			
10529	212	0012574860010	23850	21150	F	865000	1020000					
10530	212	0012574860010	26500	23500	F	1090000	248000	793000				
10531	212	0012574860010	29150	25850	F	826000	160000	158000				
10532	212	0012574861010	37100	32900	F	144000	326000	187000	538000	304000	142000	
10533	212	0012574861010	37100	32900	F	619000	411000	778000				
10534	212	0012574861010	37100	32900	F	64000	79000	141000				
10535	212	0012574861010	37100	32900	F	103000	403000	229000				
10536	212	0012574861010	37100	32900	F	207000	352000	218000	175000	95000	67000	201000
					F	120000	93000	491000	174000	102000	98000	635000
					F	63000						
10537	212	0012574861010	37100	32900	F	2013000	1284000	880000	809000	891000		
					S	2013000						
10538	212	0012574861010	37100	32900	F	1183000	677000	1031000				

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)			
10539	219	0072079873010	23850	21150	F	27000	27600		
10540	220	0000062887011	31800	28200	F	15000	18900		
10541	220	0000062883011	31800	28200	F	38000	55900		
10542	220	0050075813011	18550	16450	F	39370	33850		
10543	221	0000077860010	26500	23500	F	46000	70000		
10544	221	0000077960010	26500	23500	F	132000	87000	76000	83000
10547	218	0007078860010	31800	28200	F	27000	31000		
10548	218	0007078860010	26000	23000	F	66000	40000		
10549	218	0007078860010	21200	18800	F	243000	132000		
10550	218	0007078860010	29150	25850	F	45000	39000		
10551	218	0007078860016	26000	23000	F	33000	36000		
10552	218	0007078860016	29150	25850	F	21000	23000		
10553	218	0007078860016	31800	28200	F	11000	14000		
10554	218	0007078860016	26000	23000	F	30000	30001		
10555	218	0007078860016	29150	25850	F	16000	12000		
10556	218	0004078860010	21200	18800	F	91000	136000	85000	
10557	218	0004078860010	26500	23500	F	59000	56000	57000	98000
10558	218	0004078860010	34450	30550	F	22000	26000	25000	
10559	218	0004078860010	42400	37600	F	9999	10000	10001	
10560	218	0004078860010	47700	42300	F	3000	6000		
10561	218	0004078860010	23850	21150	F	139000	1024000	121000	
10562	218	0004078860016	26500	23500	F	35000	29000	61000	
10563	218	0004078860016	34450	30550	F	8000	8000	9000	
10564	218	0004078860016	39750	35250	F	4000	4000	5000	
10565	218	0004078860016	23850	21150	F	42000	40000		
10566	218	0004078860016	26500	23500	F	25000	26000	24000	
10567	218	0004078860016	34450	30550	F	7000	6000	7000	
10568	218	0004078860016	21200	18800	F	87000	93000	63000	
10569	218	0004078860016	42400	37600	F	999	1000	1001	
10570	218	0004078860016	39750	35250	F	4000	3000		
10571	218	0004078860016	31800	28200	F	11000	10000		
10572	218	0004078860016	26500	23500	F	258000	32000	24000	27000
10573	218	0004078860016	37100	32900	F	3000	3001		
10574	218	0004078860016	29150	25850	F	12000	13000		
10575	218	0004078860016	26500	23500	F	16000	18000		
10576	218	0004078860016	39750	35250	F	2000	2001		
10577	218	0004078860016	29150	25850	F	19000	21000		
10578	218	0004078860016	37100	32900	F	3000	2000		
10579	218	0004078860016	29150	25850	F	11000	10000		
10580	218	0004078860016	39750	35250	F	2000	3000		
10581	218	0004078860016	25450	22550	F	42000	459000		

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)		
10582	218	0004078860016	29150	25850	F	20000	20001	
10583	218	0004078860016	39750	35250	F	4000	4001	
10584	218	0004078860016	31800	28200	F	12000	13000	
10585	218	0004078860016	26500	23500	F	38000	30000	
10586	218	0004078860016	37100	32950	F	4000	4001	
10587	218	0004078860016	31800	28200	F	8000	11000	
10588	218	0004078860016	26500	23500	F	25000	25001	
10589	218	0004078860010	31800	28200	F	35000	34000	
10590	218	0004078860010	31800	28200	F	25000	25001	
10591	218	0004078860010	29150	25850	F	76000	1347000	
10592	218	0004078860016	36050	31950	F	4500	4000	
10593	218	0004078860016	30200	26800	F	10000	10001	
10594	218	0010070906010	23850	21150	F	45000	47000	31000
10595	218	0010070906010	39750	35250	F	5000	5001	
10596	218	0010070906010	15900	14100	F	529000	118000	63000
10597	218	0010065906010	31800	28200	F	13000	11000	
10598	218	0010065906010	21200	18800	F	27000	34000	47000
10599	218	0010065906010	15900	14100	F	69000	53000	94000
10600	218	0010070906010	31800	28200	F	11000	13000	12000
10601	218	0010070906010	21200	18800	F	55000	37000	
10602	218	0010079906010	21200	18800	F	94000	36000	77000
10603	218	0010079906010	31800	28200	F	11000	11001	
10604	218	0010079906010	15900	14100	F	59000	111000	
10605	218	0024079960010	31800	28200	F	27710	28520	90160
10606	218	0024079960010	26500	23500	F	77990	196500	
10607	218	0006360960010	31800	28200	F	23000	23000	17000
10608	218	0006360960010	26500	23500	F	49000	49000	40000
10609	218	0006360960010	21200	18800	F	308000	114000	100000
10610	218	0006360960310	31800	28200	F	16000	15000	15000
10611	218	0006360960310	26500	23500	F	56000	35000	34000
10612	218	0006360960310	21200	18800	F	90000	68000	66000
10613	218	0006360960310	18550	16450	F	2016000	94000	
					S	2016000		
10614	218	0006360960310	31800	28200	F	12000	10000	
10615	218	0006360960310	26500	23500	F	23000	23000	21000
10616	218	0006360960310	21200	18800	F	190000	74000	57000
10617	218	0006360960310	18550	16450	F	2860000	100000	
					S	2860000		
10618	218	0050061860010	29150	25850	F	126000	351100	82940
10619	218	0050061860010	36150	32050	F	49460	65820	
10620	218	0050061860010	29150	25850	F	79540	749740	99540

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)			
10621	218	0050061860010	36150	32050	F	36350	49620		
10622	221	0000068960910	23850	21150	F	31000	46000	98000	135000
10623	221	0000063860010	23850	21150	F	83000	85000	138000	
10624	221	0000063960010	23850	21150	F	98000	100000	126000	133000
10625	221	0000069860010	23850	21150	F	75000	150000		
10626	221	0000069960010	23850	21150	F	115000	140000	174000	458000
10627	221	0000063860010	23850	21150	F	70000	72000	74000	
10628	221	0000063960010	23850	21150	F	55000	65000	74000	161000
10629	221	0000069860010	23850	21150	F	44000	92000	151000	
10630	221	0000069960010	23850	21150	F	49000	51000	68000	112000
10631	221	0003078860010	25440	22560	F	1000000	95000	287000	
					S	1000000			
10632	221	0003078860010	31800	28200	F	34000	45000		
10633	221	0003060860010	25440	22560	F	77000	125000	159000	
					S	77000	125000		
10634	222	0006360865010	65000	19500	F	53000	151000		
10635	222	0006360865010	60000	18000	F	191000	273000		
10636	222	0006360865010	62000	18600	F	150000	156000		
10637	222	0006360865016	54000	16200	F	51000	73000		
10638	222	0006360865016	60000	18000	F	67000	78000		
10639	222	0006360865016	52000	15600	F	564000	4567000		
10640	222	0006360865016	47000	14100	F	782000	2680000		
10641	222	0006360865010	30000	30000	F	67000	130000		
10642	222	0006360865010	31000	31000	F	30000	60000		
10643	222	0006360865010	29000	29000	F	65000	168000		
10644	222	0006360865010	27500	27500	F	171000	460000		
10645	222	0006360865010	27000	27000	F	131000	202000	358000	
10646	222	0006360865016	30000	30000	F	23000	33000	71000	
10647	222	0006360865016	29000	29000	F	47000	60000		
10648	222	0006360865016	27000	27000	F	57000	3528000		
10649	222	0006360865016	33000	33000	F	23000	30000		
10650	222	0006360865016	35000	35000	F	15000	16000		
10651	222	0006360865016	31000	31000	F	22000	22100		
10652	222	0006360865016	28000	28000	F	22000	55000		
10653	222	0006360865016	26000	26000	F	32000	5788000		
10654	222	0006360865016	27500	27500	F	68000	71000		
10655	222	0006360865010	0	41000	F	59000	865000		
10656	222	0006360865010	0	46000	F	23000	34000		
10657	222	0006360865010	0	42000	F	86000	200000		
10658	222	0006360865010	0	43000	F	39000	320000		
10659	222	0006360865016	0	40000	F	28000	56000		

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
10660	222	0006360865016	0	35000	F	51000	59000			
10661	222	0006360865016	0	32000	F	48000	134000			
10662	222	0006360865016	0	38000	F	34000	56000			
10663	222	0006360865016	0	33000	F	23000	1492000			
10664	222	0006360865016	0	36000	F	18000	36000			
10665	222	0006360865016	0	30000	F	276000	1144000			
10666	222	0006360865016	0	28000	F	233000	3938000			
10667	223	0038076869010	31800	28200	F	1872000	1032000	4024000		
10668	223	0010074813010	31800	28200	F	18000	25000	29900		
10669	223	0006078812010	31800	28200	F	5000	4000	4000		
10670	223	0010074813010	31800	28200	F	19000	20000	18000		
10671	223	0006078813010	31800	28200	F	8600	11000	13000		
10672	223	0006078813010	22600	20000	F	53000	56000	57000		
10673	220	0012071863010	23850	21150	F	254000	274000			
10674	220	0020071863010	31800	28200	F	255000	544000	114000	179000	
10675	224	0004078871210	31800	28200	F	3548000	535000	750000		
10676	224	0004078871210	34450	30550	F	328000	301000			
10677	224	0004078871210	31800	28200	F	426000	10039000			
10678	224	0003278871210	31800	28200	F	430000	407000			
10679	224	0002578871210	34450	30550	F	76000	223000			
10680	224	0003278871210	31800	28200	F	366000	4088000	189000	1621000	
10681	224	0012578861010	31800	28200	F	617000	358000			
10682	224	0012578861010	29150	25850	F	2277000	301000			
10683	224	0012578861010	31800	28200	F	168000	169000			
10684	224	0012578861010	31800	28200	F	45000	42000			
10685	224	0004078871210	31800	28200	F	491000	403000			
10686	224	0005078871010	31800	28200	F	1429000	351000			
10687	224	0006078871010	39800	35200	F	502000	806000			
10688	224	0006078871010	37100	32900	F	956000	354000			
10689	224	0006078871010	37100	32900	F	132000	322000			
10690	224	0006078871010	31800	28200	F	855000	1799000			
10691	224	0009078871010	31800	28200	F	1014980	362170			
10692	224	0009078871010	31800	28200	F	311790	329100			
10693	224	0009078871010	37100	32900	F	364710	322730	172520		
10693	224	0009078871010	31300	28200	F	569430	303260			
10694	224	0018878871010	31800	28200	F	474840	532890			
10695	224	0018878871010	31800	28200	F	588000	2174000			
10696	224	0025078871010	31800	28200	F	195440	162140			
10697	224	0025078871010	31800	28200	F	273000	328850			
10698	225	0009360823010	21200	18800	F	30000	32000	36000	37000	34000
10699	225	0009360823010	21200	18800	F	20000	20000	19000	33000	15000

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
10700	225	0009360823010	21200	18800	F	32000	34000	34000	42000	43000		
10701	226	0006360960010	42400	37600	F	12000	11000	11000				
10702	226	0006360960810	42400	37600	F	9000	8000	8000				
10703	226	0006360960010	31800	28200	F	68000	35000	31000	27000			
10704	226	0006360960810	31800	28200	F	46000	36000	33000	32000			
10705	226	0006360960010	26500	23500	F	2590000	2410000	1943000	1692000	1652000	1565000	132000
					F	99000	69000					
10706	226	0006360960810	26500	23500	F	155000	102000	96000	88000			
10707	226	0006360960010	23850	21150	F	4724000	3834000	3474000	3227000	2630000	2164000	
10708	226	0006360960810	23850	21150	F	3866000	3725000	3621000	114000	104000	91000	87000
10709	227	0005063860010	21200	18800	F	164000	115000	80000	175000	164000	124000	
10710	227	0005063860010	29150	25850	F	29000	47000	37000	37000	31000	40000	
10711	227	0005063860010	21200	18800	F	171000	81000	65000	99000	64000	97000	
10712	227	0005063860010	29150	25850	F	17000	23000	27000	25000	19000	26000	
10716	227	0006360869210	37100	32900	F	182000	96000	93000				
10717	227	0006360869210	42400	37600	F	76000	45000					
10718	227	0009060869210	42400	37600	F	5576000	602000	115000				
					S	5576000						
10719	227	0009060869210	47700	42300	F	39000	24000					
10720	227	0006360869210	53000	47000	F	56000	46000					
10721	227	0006360869210	47700	42300	F	167000	71000	100000				
10722	227	0006360869210	47700	42300	F	77000	74000					
10723	227	0006360869210	53000	47000	F	40000	43000					
10724	227	0006360869210	45000	40000	F	88000	75000					
10725	227	0006360869210	37100	32900	F	46000	47000					
10726	227	0006360869210	31800	28200	F	89000	70000					
10727	227	0009060869210	37100	32900	F	696000	51000	71000				
10728	227	0009060869210	42400	37600	F	35000	43000					
10729	227	0006360969210	42400	37600	F	40000	28000					
10730	227	0006360969210	37100	32900	F	46000	185000	81000				
10731	227	0006360969210	47700	42300	F	20000	21000					
10732	227	0009060869210	47700	42300	F	2000000	101000					
					S	2000000						
10732	227	0009060869210	53000	47000	F	79000	701000	77000				
10733	227	0009060869210	58300	51700	F	47000	90000					
10734	228	0025061833010	21200	18800	F	429470	465280	376010	257950	405110	411100	297770
					F	313270	534430	246810	248930	252960		
10735	228	0025061833010	26500	23500	F	163590	204150	222910	98720	135740	194180	157300
					F	34630	242210	144070				
10736	228	0025061833010	31800	28200	F	98820	36690	39390	87420	52880	60190	108260
					F	89030	132900	122770	118450	105100		

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)		
10737	228	0025061833010	39800	35200	F	6510	5390	
10738	228	0009060873016	26500	23500	F	44000	60000	
					S	44000		
10739	228	0009060873016	21200	18800	F	183000	197000	
					S	183000		
10740	228	0009060873016	26500	23500	F	70000	42000	
					S	70000		
10741	228	0009060873016	31800	28200	F	29000	43000	42000
10742	228	0009060873016	21200	18800	F	95000	148000	
					S	95000		
10743	228	0009060873017	26500	23500	F	74000	52000	
10744	228	0009060873016	31800	28200	F	31000	23000	9000
10745	228	0009060873016	21200	18800	F	32000	120000	
					S	32000		
10746	228	0009060873011	31800	28200	F	26000	24000	28000
10747	228	0009060873010	26500	23500	F	44000	59000	
					S	44000		
10748	228	0009060873011	21200	18800	F	111000	76000	126000
10749	228	0009060873011	31800	28200	F	35000	28000	
10750	228	0009060873010	26500	23500	F	83000	78000	114000
10751	228	0009060873010	21200	18800	F	89000	305000	79000
10753	228	0009060873010	31800	28200	F	32000	22000	19000
10754	228	0009060873010	26500	23500	F	27000	30000	59000
10755	228	0009060873011	21200	18800	F	306000	91000	
10756	229	0004060860210	31800	28200	F	14000	19000	15000
10757	229	0004060860210	18550	16450	F	216000	128000	81000
10758	229	0004060860410	31800	28200	F	36000	27000	
10759	229	0004060860410	18550	16450	F	10263000	4978000	
					S	10263000		
10760	229	0004060860410	31800	28200	F	15000	17000	
10761	229	0004060860410	21200	18800	F	7709000	57000	821000
10762	229	0004060860410	31800	28200	F	17000	24000	
10763	229	0004060860410	21200	18800	F	71000	84000	
10764	229	0004060860410	31800	28200	F	14000	11000	
10765	229	0004060860410	21200	18800	F	120000	101000	
10766	229	0006060860010	26500	23500	F	61000	76000	
10767	229	0006060860010	31800	28200	F	9000	26000	
10768	229	0006060860010	39800	35200	F	10000	9000	11000
10769	229	0006060860010	25400	22600	F	68000	72000	
10770	229	0006360860010	18550	16450	F	268000	9396000	
10771	229	0006360860010	21200	18800	F	106000	107000	

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)			
10772	229	0004060860010	31800	28200	F	11000	19000		
10773	229	0004060860010	37100	32900	F	6000	8000		
10774	229	0004060860010	21200	18800	F	56000	91000		
10775	229	0004060860010	18550	16450	F	109001	109000		
10776	229	0004060860010	16950	15050	F	192000	168000		
10777	229	0006070860010	21200	18800	F	10000000	68000		
					S	10000000			
10778	229	0006070860010	31800	28200	F	17000	14000		
10779	229	0004070860010	31800	28200	F	32000	26000		
10780	229	0004070860010	21200	18800	F	136000	85000		
10781	229	0004070860010	37100	32900	F	13000	12000		
10782	229	0004070860010	18550	16450	F	161000	177000		
10783	229	0004070860010	18000	16000	F	209000	7833000		
10784	229	0004070871010	31800	28200	F	10000000	425000	251000	
					S	10000000			
10785	229	0004070871010	42400	37600	F	18000	29000		
10786	229	0004070871010	37100	32900	F	164000	48000		
10787	230	0025070863010	37100	32900	F	70250	53600		
10788	230	0025070863010	29200	25800	F	142000	168020		
10789	230	0025070863010	29200	25800	F	125150	229610	120900	86060
10790	231	0012560071010	26500	23500	F	201630	810080		
10791	231	0012560071010	26500	23500	F	1301070	2573740		
10793	231	0012560071010	26500	23500	F	1577800	1202810		
10792	231	0012560071010	31800	28200	F	563180	211990	170410	
10794	231	0012560071016	26500	23500	F	310570	348690		
10795	231	0012560071010	31800	28200	F	491000	534120	718440	
10796	231	0012560071010	26500	23500	F	113950	145930	228610	
10797	231	0012560071010	26500	23500	F	159020	171300		
10798	231	0012560071010	31800	28200	F	148110	150050		
10799	231	0004074061210	34450	30550	F	301000	328000		
10800	231	0004074061210	31800	28200	F	535000	3548000		
10801	231	0003274061210	31800	28200	F	407000	430000		
10802	231	0002574061210	34450	30550	F	76000	223000		
10803	231	0003274061210	31800	28200	F	189000	366000	947000	4033000
10804	231	0004078871010	39800	35200	F	76000	199000		
10805	231	0004078871010	37100	32900	F	402000	640000		
10806	231	0004078871010	31800	28200	F	2253000	3750000		
10807	231	0004078871010	37100	32900	F	165000	201000		
10808	231	0004078871010	31800	28200	F	152000	491000	403000	
10809	231	0004078871010	31800	28200	F	36000	105000		
10810	231	0005078871010	31800	28200	F	351000	1429000		

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)		
10811	231	0006078871010	39800	35200	F	502000	806000	
10812	231	0006078871010	37100	32900	F	354000	956000	
10813	231	0006078871010	37100	32900	F	132000	322000	
10814	231	0006078871010	31800	28200	F	855000	1799000	
10815	231	0006078871010	31800	28200	F	290000	4501000	
10816	231	0009078871010	31800	28200	F	362170	1014980	
10817	231	0009078871010	31800	28200	F	311790	329100	
10818	231	0009078871010	37100	32900	F	172520	322730	364710
10819	231	0009078871010	31800	28200	F	303260	569430	
10820	231	0018878871010	31800	28200	F	535300	2174800	
10821	231	0018878871010	31800	28200	F	474890	532890	
10822	231	0025078871010	31800	28200	F	195440	162140	
10823	231	0025078871010	31800	28200	F	273000	328850	
10824	231	0012570871010	31800	28200	F	234410	254420	354530
10825	231	0012570871010	31800	28200	F	90270	114850	
10826	231	0012570871010	31800	28200	F	178280	200820	
10827	231	0012574871010	31800	28200	F	41900	67900	
10828	231	0012564871010	42400	37600	F	39600	59000	
10829	231	0012564871010	37100	32900	F	58300	114400	152800
10830	231	0012564871010	31800	28200	F	10000000	297860	100200
					S	10000000		
10831	231	0012564871010	37100	32900	F	107200	296600	
10832	311	0012564871010	31800	28200	F	179400	421300	459000
10833	231	0012564871010	37100	32900	F	66500	67800	96900
10834	231	0012564871010	31800	28200	F	72900	79600	
10835	231	0012564871010	37100	32900	F	142000	321000	
10836	231	0012564871010	37100	32900	F	92300	96900	115300
10837	231	0012564871010	31800	28200	F	175000	471600	
10838	231	0012570871010	37100	32900	F	78700	117100	132400
10839	231	0012570871010	37100	32900	F	117300	48100	119400
10840	231	0012570871010	37100	32900	F	68200	142300	
10841	231	0012570871010	37100	32900	F	79100	69100	74600
10842	231	0012564871010	31800	28200	F	313420	325900	
10843	231	0012564871010	26500	23500	F	794350	256510	
10844	231	0012564871010	22500	37500	F	116790	165520	
10845	231	0012564871010	18750	31250	F	306280	450430	
10846	231	0012564871010	16950	28250	F	460030	562750	4054760
10847	231	0012570873010	31800	28200	F	56560	57080	
10848	231	0012570873010	26500	23500	F	91270	94630	
10849	231	0012570873010	21200	18800	F	493020	1022670	
10850	231	0012570873016	31800	28200	F	76040	85300	

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)			
10851	231	0012570871010	31800	28200	F	352630	390020	397970	422060
10852	231	0012570871010	31800	28200	F	190600	246750		
10853	231	0004060871010	31800	28200	F	68000	97000		
10854	231	0004060871010	26500	23500	F	1143000	1444000		
10855	231	0004060871010	31800	28200	F	51000	59000		
10856	231	0004060871010	26500	23500	F	100000	201000		
10857	231	0004060871010	26500	23500	F	40000	43000		
10858	231	0004060871010	21200	18800	F	79000	110000		
10859	231	0004060871010	26500	23500	F	39000	45000		
10860	231	0004060871010	26500	23500	F	38000	51000		
10861	231	0004060871010	23850	21150	F	153000	129000		
10862	231	0004060871010	21200	18800	F	188000	213000		
10863	231	0004060871010	26500	23500	F	46000	96000		
10864	231	0006360871010	31800	28200	F	5387000	1446000		
10865	231	0006360871010	29150	25850	F	916000	2780000		
10866	231	0006360871010	56000	24000	F	165000	189000		
10867	231	0006360871010	31800	28200	F	247000	541000		
10868	231	0006360871010	37100	32900	F	127000	183000		
10869	231	0006360871010	37100	32900	F	117000	123000		
10870	231	0006360871010	31800	28200	F	140000	238000	338000	
10871	231	0006360871010	37100	32900	F	120000	224000		
10872	231	0006360871010	31800	28200	F	3570000	4355000		
10873	231	0006360871010	37100	32900	F	94000	96000		
10874	231	0006360871010	31800	28200	F	130000	194000		
10875	231	0006360871010	29150	25850	F	159000	319000		
10876	231	0006360871010	42400	37600	F	63000	58000		
10877	231	0006360871010	31800	28200	F	1891000	1025000	295000	
10878	231	0006360871010	42400	37600	F	40000	57000		
10879	231	0006360871010	37100	32900	F	120000	152000		
10880	231	0006360871010	31800	28200	F	1382000	210000	217000	
10881	231	0006360871010	29150	25850	F	2247000	391000		
10882	231	0006360871010	42400	37600	F	85000	103000		
10883	231	0006360871010	37100	32900	F	181000	207000		
10884	231	0006360871010	31800	28200	F	277000	3550000		
10885	231	0006360871010	37100	32900	F	88000	132000	168000	
10886	231	0006360871210	31800	28200	F	188000	238000		
10887	231	0006360871210	29150	25850	F	239000	387000		
10888	231	0006360871210	31800	28200	F	213000	242000		
10889	231	0006360871410	37100	32900	F	101000	129000		
10890	231	0006360871410	31800	28200	F	107000	188000	538000	
10891	231	0006360871410	29150	25850	F	187000	878000		

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)		
10892	231	0006360871410	21200	18800	F	505000	1259000	
10893	231	0006360871010	26500	23500	F	151000	122000	
10894	231	0012578871010	31800	28200	F	353000	617000	
10895	231	0012578871010	29150	2585	F	301000	2277000	
10896	231	0012578871010	31800	28200	F	168000	169000	
10897	231	0012578871010	31800	28200	F	42000	45000	
10898	231	0004070871010	31800	28200	F	15260	11408	16640
10899	231	0004070871016	31800	28200	F	6156	5732	9514
10900	231	0004070871010	31800	28200	F	21069	24910	
10901	231	0004070871016	31800	28200	F	6863	19699	14599
10902	231	0004070871080	VARIABLE AMP. LOADS		F	15260	11408	16640
10903	231	0004070871086	VARIABLE AMP. LOADS		F	6156	5732	9514
10904	231	0004074873010	31800	28200	F	15000	19000	
10905	231	0003274873010	13250	11750	F	1196000	1202000	
10906	231	0004074873010	13250	11750	F	706000	731000	
10907	231	0012560833010	31800	28200	F	19000	41000	
10908	231	0012560833010	26500	23500	F	111000	156000	
10909	231	0012560833010	26500	23500	F	66000	84000	
10910	231	0012560833010	18550	16450	F	195000	306000	
10911	231	0012560833010	21200	18800	F	74000	77000	
10912	231	0012560833010	21200	18800	F	123000	135000	
10913	231	0012560833010	26500	23500	F	85000	89000	
10914	231	0012560833010	21200	18800	F	130000	279000	
10915	231	0012560833010	21200	18800	F	116000	117000	
10916	231	0012560833010	15900	14100	F	768000	944000	
10917	231	0012560833210	26500	23500	F	90000	201000	
10918	231	0007260813010	15900	14100	F	67000	95000	
10919	231	0007260813010	10600	9400	F	157000	202000	
10920	231	0007260813010	15900	14100	F	43000	49000	
10921	231	0007260813010	10600	9400	F	113010	113000	
10922	231	0007260813010	7950	7050	F	275000	342000	
10923	231	0007260813010	10600	9400	F	61000	65000	67000
10924	231	0007260813010	7950	7050	F	149000	162000	
10925	231	0007260813010	21200	18800	F	30000	61000	
10926	231	0007260813010	15900	14100	F	101000	126000	
10927	231	0007260813010	10600	9400	F	263000	307000	
10928	231	0007260813010	15900	14100	F	75000	84000	
10929	231	0007260813010	15900	14100	F	101000	117000	263000
10930	231	0007260813010	10600	9400	F	159000	191000	
10931	231	0007260811010	15900	14100	F	52000	60000	
10932	231	0007260811010	13250	11750	F	91000	101000	

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)		
10933	231	0007260811010	10600	9400	F	516000	684000	
10934	231	0007260813010	15900	14100	F	140000	149000	
10935	231	0007260813010	10600	9400	F	393000	444000	
10936	231	0007260813010	15900	14100	F	55000	56000	140000
10937	231	0007260813010	10600	9400	F	142000	1036000	
10938	231	0007260833010	31800	28200	F	92000	152000	
10939	231	0007260833010	26500	23500	F	171000	182000	
10940	231	0007260833010	31800	28200	F	97000	187000	221000
10941	231	0007260833010	26500	23500	F	216000	272000	
10942	231	0007260833010	37100	32900	F	54000	55000	77000
10943	231	0007260833010	31800	28200	F	167000	182000	
10944	231	0007260831010	31800	28200	F	24000	90000	
10945	231	0007260831010	26500	23500	F	2722000	133000	
					S	2722000		
10946	231	0007260833010	31800	28200	F	82000	98000	
10947	231	0007260833010	26500	23500	F	95000	162000	
10948	231	0007260813010	26500	23500	F	19000	21000	
10949	231	0007260813010	21200	18800	F	63000	256000	308000
10950	231	0007260813010	15900	14100	F	64000	88000	
10951	231	0007260813010	10600	9400	F	168000	169000	
10952	231	0007260813010	31800	28200	F	33000	106000	113000
10953	231	0007260813010	26500	23500	F	153000	220000	
10954	231	0007260813010	26500	23500	F	11000	37000	
10955	231	0007260813010	21200	18800	F	73000	95000	
10956	231	0007260813010	15900	14100	F	410000	508000	
10957	231	0004060813210	21200	18800	F	60000	80000	
10958	231	0004060813210	15900	14100	F	166000	170000	
10959	231	0004060813210	21200	18800	F	70000	78000	
10960	231	0004060813210	15900	14100	F	120000	193000	
10961	231	0001660060810	21200	18800	F	42000	48000	
10962	231	0001660060810	15900	14100	F	100000	124000	
10963	231	0000060060010	26500	23500	F	32000	38000	
10964	231	0000060060010	21200	18800	F	92000	111000	
10965	231	0004060860010	32000	28000	F	16775	24885	36580
10966	231	0004060860016	32000	28000	F	11716	10789	11046
10967	231	0004060860010	32000	28000	F	26179	41963	15520
10968	231	0004060860016	32000	28000	F	10236	9853	9213
10969	231	0004060860010	32000	28000	F	24270	27140	42640
10970	231	0004060860016	32000	28000	F	13120	10620	10690
10971	231	0004060860080	VARIABLE AMP. LOADS		F	11440	6972	4620
10972	231	0004060860086	VARIABLE AMP. LOADS		F	3396	3696	5364

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
10973	231	0004066860010	32000	28000	F	12675	9301	15485				
10974	231	0004066860016	32000	28000	F	3693	7127	5280				
10975	231	0004066860010	32000	28000	F	12504	13193	15650				
10976	231	0004066860016	32000	28000	F	6180	6328					
10977	231	0004066860010	32000	28000	F	20580	14560	16210				
10978	231	0004066860016	32000	28000	F	15780	7990	10220				
10979	231	0004066860080	VARIABLE AMP. LOADS		F	6234	4346	5768				
10980	231	0004066860086	VARIABLE AMP. LOADS		F	2548	2782	2974				
10981	231	0007260860810	21200	18800	F	67000	75000					
10982	231	0007260860810	15900	14100	F	140000	167000					
10983	231	0007260860010	21200	18800	F	82000	91000					
10984	232	0004282850011	60000	40000	F	12000	14000	14000	15000	17000		
10985	232	0004282860011	60000	40000	F	12000	13000	13000	13000			
10986	232	0004282860011	60000	40000	F	9000	12000	14000	14000	15000	15000	15000
					F	15000	17000	18000	19000			
10987	232	0004282860011	60000	40000	F	13000	14000	18000	37000			
10988	232	0004282860011	60000	40000	F	15000	16000	17000	18000	19000	37000	
10989	232	0004282860011	60000	40000	F	7000	8000	13000	14000	15000	16000	18000
10990	232	0004282860011	60000	40000	F	12000	16000					
10991	232	0004282860011	60000	40000	F	4000	9000					
10992	232	0004282860011	60000	40000	F	10000	12000	12000	16000	23000		
10993	232	0004282860011	60000	50000	F	11000	11000	11000	14000			
10994	232	0004282860011	60000	50000	F	9000	11000	12000				
10995	232	0004282860011	60000	50000	F	11000	17000	19000				
10996	232	0004282860011	60000	50000	F	11000	12000	15000				
10997	232	0004282860011	60000	50000	F	12000	13000					
10998	232	0004282860011	60000	50000	F	9000	11000	11000				
10999	232	0004282860011	60000	50000	F	11000	13000	15000	23000			
11000	232	0004282860011	60000	50000	F	13000	15000					
11001	232	0004282860011	60000	50000	F	10000	10000	27000				
11002	232	0004282860011	60000	50000	F	10000	11000	13000				
11003	232	0004282860011	60000	50000	F	11000	12000	14000	17000			
11004	232	0004282860011	60000	50000	F	12000	24000					
11005	232	0004282860011	60000	50000	F	10000	15000					
11006	232	0004282860011	60000	50000	F	9000	15000					
11007	232	0004282860011	60000	50000	F	4000	11000					
11008	232	0004282860011	60000	50000	F	9000	13000					
11009	232	0004282860011	60000	50000	F	9000	12000	12000				
11010	232	0004282860011	60000	50000	F	12000	21000					
11011	232	0004282860011	60000	50000	F	12000	13000					
11012	232	0004282860011	0	34000	F	20000	117000					

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)		
11013	232	0004282860011	0	35000	F	27000	32000	
11014	232	0004282860011	0	36000	F	11000	14000	
11015	232	0004282860011	0	40000	F	18000	34000	
11016	232	0004282860011	20000	23000	F	30000	126000	
11017	232	0004282860011	20000	26000	F	16000	44000	
11018	232	0004282860011	20000	30000	F	5000	18000	
11019	232	0004282860011	20000	33000	F	2000	10000	
11020	232	0004282860011	0	33000	F	22000	63000	
11021	232	0004282860011	0	34000	F	9000	22000	
11022	232	0004282860011	0	36000	F	29000	36000	
11023	232	0004282860011	20000	24000	F	77000	923000	
11024	232	0004282860011	20000	26000	F	18000	22000	
11025	232	0004282860011	20000	30000	F	9000	27000	
11026	232	0004282860011	20000	33000	F	2000	3000	
11027	232	0004282860011	40000	8000	F	15000	182000	
11028	232	0004282860011	40000	10000	F	17000	25000	35000
11029	232	0004282860011	40000	12000	F	5000	9000	11000
11030	232	0004282860010	0	34000	F	87000	170000	263000
11031	232	0004282860010	0	35000	F	48000	65000	
11032	232	0004282860010	0	36000	F	32000	34000	35000
11033	232	0004282860010	0	40000	F	40000	56000	
11034	232	0004282860010	20000	23000	F	8943000	177000	
					S	8943000		
11035	232	0004282860010	20000	24000	F	89000	120000	
11036	232	0004282860010	20000	26000	F	44000	101000	
11037	232	0004282860010	20000	30000	F	22000	35000	
11038	232	0004282860010	20000	33000	F	13000	27000	
11039	232	0004282860010	40000	11000	F	137000	169000	
11040	232	0004282860010	40000	12000	F	66000	87000	
11041	232	0004282860010	40000	13000	F	62000	66000	72000
11042	232	0004282860010	40000	14000	F	64000	101000	
11043	232	0004282860010	0	33000	F	38000	82000	
11044	232	0004282860010	0	34000	F	22000	39000	139000
11045	232	0004282860010	0	36000	F	47000	49000	
11046	232	0004282860010	0	38000	F	10000	13000	
11047	232	0004282860010	20000	22000	F	99000	1153000	
11048	232	0004282860010	20000	24000	F	5018000	941000	
					S	5018000		
11049	232	0004282860010	20000	26000	F	33000	37000	
11050	232	0004282860010	20000	30000	F	22000	41000	
11051	232	0004282860010	20000	33000	F	13000	15000	

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
11052	232	0004282860010	40000	6000	F	316000	381000			
11053	232	0004282860010	40000	8000	F	130000	304000			
11054	232	0004282860010	40000	10000	F	74000	80000	96000		
11055	232	0004282860010	40000	12000	F	44000	46000	46000		
11056	233	0004582812010	6250	18750	F	10000	11000	14000	15000	15000
11057	233	0004582812010	25000	55000	F	949	1503	5000		
11058	233	0004582812010	25000	15000	F	43000	47000	58000		
11059	233	0004582812010	25000	35000	F	6060	7240	8000		
11060	233	0004582812016	25000	15000	F	31000	47000	49000		
11061	233	0004582812016	25000	30000	F	5160	6420	9260		
11062	233	0004582812016	25000	45000	F	1730	2160	3080		
11063	234	0003778811011	13750	11250	F	172154	204450			
11064	234	0003778811011	13750	11250	F	111965	138900			
11065	234	0003778811017	13750	11250	F	55000	66042	123560		
11066	234	0003778811019	13750	11250	F	101000	192000	257300		
11067	234	0003778811010	13750	11250	F	128340	173570			
11068	234	0003778811010	13750	11250	F	182080	237680			
11069	234	0003778811016	13750	11250	F	67400	79850	138590		
11070	234	0003778811018	13750	11250	F	225500	297600	322600		
11071	234	0004060811011	VARIABLE AMP. LOADS		F	15600	15650	19000	20500	
11072	234	0004060811011	VARIABLE AMP. LOADS		F	9400	16200	24000	25000	
11073	234	0004060811011	VARIABLE AMP. LOADS		F	5000	8300			
11074	234	0004060811011	VARIABLE AMP. LOADS		F	5600	6000	6350	6500	
11075	234	0004060811011	VARIABLE AMP. LOADS		F	5600	5600	6350	6500	
11076	234	0004060811011	VARIABLE AMP. LOADS		F	1000	3000	4500	4600	
11077	234	0004060811011	VARIABLE AMP. LOADS		F	3500	4500	4600	5200	
11078	235	0012563860010	23850	21150	F	83000	85000	138000		
11079	235	0012563960010	23850	21150	F	98000	100000	126000	133000	
11080	235	0012563860910	23850	21150	F	70000	72000	74000		
11081	235	0012563960910	23850	21150	F	55000	65000	74000	161000	
11082	235	0012569860010	23850	21150	F	75000	150000			
11083	235	0012569960010	23850	21150	F	115000	140000	174000	458000	
11084	235	0012569860910	23850	21150	F	44000	92000	151000		
11085	235	0012569960910	23850	21150	F	49000	51000	68000	112000	
11086	236	0012577860010	26500	23500	F	46000	70000			
11087	236	0012577960010	26500	23500	F	76000	83000	87000	132000	
11088	237	0005068860010	49335	40365	F	5500	5800	6200		
11089	237	0005068860010	39655	32445	F	12400	12700	13900		
11090	237	0005068860010	29700	24300	F	24800	25200	28000		
11091	237	0005068860010	20240	16560	F	118500	152100	167500		
11092	237	0005068860010	24750	20250	F	54350	108600			

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)					
11093	237	0005068860010	33637	56063	F	3700	4400	4800			
11094	237	0005068860010	27037	45068	F	5850	9600	10150			
11095	237	0005068860010	20250	33750	F	16050	18250	32150			
11096	237	0005068860010	17250	28750	F	33700	42300	54850			
11097	237	0005068860010	15000	25000	F	52300	93650	327400			
11098	237	0005068860016	44000	36000	F	3600	5400	6400			
11099	237	0005068860016	33000	27000	F	11150	14250	18600			
11100	237	0005068860016	24750	20250	F	29550	37350				
11101	237	0005068860016	23100	18900	F	51000	122600				
11102	237	0005068860016	26400	21600	F	30350	32800				
11103	237	0005068860016	30000	50000	F	1750	2700	3450			
11104	237	0005068860016	22500	37500	F	6800	9500	12200			
11105	237	0005068860016	16875	28125	F	25350	28000	29100			
11106	237	0005068860016	11250	18750	F	67300	93200				
11107	217	0012560879210	53000	47000	F	24000	25000	27000			
11108	217	0012560879210	39750	35250	F	77000	141000	189000	209000		
11109	217	0012560019220	0	96000	F	9000	11000				
11110	217	0012560019020	0	47800	F	114000	360000	363000			
11111	217	0012560019020	0	95500	F	3000	6000				
11112	217	0012560019020	66460	57440	F	13000	39000				
11113	217	0012560019020	50615	44885	F	688000	941000				
11114	217	0012560979210	53000	47000	F	18000	39000	70000	107000	142000	
11115	217	0012560979210	39750	35250	F	105000	138000	920000	1210000		
11116	232	0004282860011	60000	50000	F	12000	12100				
11117	232	0004282860011	60000	40000	F	11000	11000	12000	12000	16000	31000
11118	232	0004282860011	60000	40000	F	15000	15000	17000			
11119	232	0004282860011	60000	40000	F	9000	10000	12000	15000	16000	
11120	232	0004282860011	60000	40000	F	12000	12000	15000			
11121	232	0004282860011	60000	40000	F	9000	17000				
11122	232	0004282860011	60000	40000	F	9000	12000	17000			
11123	232	0004282860011	60000	40000	F	17000	18000				
11124	232	0004282860011	60000	40000	F	10000	11000				
11125	232	0004282860011	60000	40000	F	10000	12000				
11126	232	0004282860011	0	34000	F	67000	53000				
11127	232	0004282860011	0	35000	F	33000	21000				
11128	232	0004282860011	0	36000	F	21000	23000				
11129	232	0004282860011	0	40000	F	22000	22100				
11130	232	0004282860011	20000	23000	F	36000	51000				
11131	232	0004282860011	20000	26000	F	28000	57000				
11132	232	0004282860011	20000	30000	F	17000	17050				
11133	232	0004282860011	20000	33000	F	17000	11000				

TITANIUM FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)		
11134	232	0004282860011	40000	11000	F	72000	119000	
11135	232	0004282860011	40000	12000	F	76000	54000	
11136	232	0004282860011	40000	13000	F	61000	60000	
11137	232	0004282860011	0	33000	F	16000	19000	
11138	232	0004282860011	0	34000	F	13000	17000	
11139	232	0004282860011	0	36000	F	20000	11000	
11140	232	0004282860011	0	38000	F	10000	11000	
11141	232	0004282860011	20000	24000	F	20000	18000	
11142	232	0004282860011	20000	26000	F	15000	15050	
11143	232	0004282860011	20000	30000	F	13000	14000	
11144	232	0004282860011	20000	33000	F	11000	13000	
11145	232	0004282860011	40000	8000	F	122000	115000	
11146	232	0004282860011	40000	10000	F	55000	57000	61000
11147	232	0004282860011	40000	12000	F	35000	37000	39000
11148	232	0004282860011	40000	11000	F	97000	18000	
11149	232	0004282860011	40000	12000	F	11000	12000	
11150	232	0004282860011	40000	13000	F	5000	12000	

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)			
20001	330	0325043969016	88000	72000	F	4860	2000		
20002	330	0325043969016	33000	27000	F	62780	296560		
20003	330	0325043969016	44000	36000	F	19820	25800		
20004	330	0410044960010	59500	59500	F	12100	12000		
20005	330	0410044960010	47500	47500	F	19000	21000		
20006	330	0410044960010	41500	41500	F	28000	59000		
20007	330	0435444965010	75000	75000	F	2100	2000		
20008	330	0435444965010	67500	67500	F	4000	3000		
20009	330	0435444965010	60000	60000	F	5000	4000		
20010	330	0435444965010	50000	50000	F	6100	6000		
20011	330	0435444965010	40000	40000	F	15000	13000		
20012	330	0435444965010	35000	35000	F	46000	27000		
20013	330	0435444965010	70000	30000	F	27000	22000	25000	
20014	330	0600045969010	54000	36000	F	20000	21000		
20015	330	0600045869010	42000	28000	F	90000	71000		
20016	330	0600045869010	51000	34000	F	41000	18000		
20017	330	0600045869010	0	55000	F	36000	43000		
20018	330	0600045869010	0	70000	F	43000	14000		
20019	330	0600045869010	0	60000	F	52000	39000		
20020	330	0600045969010	0	70000	F	11100	11000		
20021	330	0600045969010	0	60000	F	175000	28000		
20022	330	0600045969010	0	65000	F	10000	43000		
20023	330	0535745865010	176000	144000	F	132	123		
20024	330	0535745865010	132000	108000	F	389	351		
20025	330	0535745865010	110000	90000	F	815	642		
20026	330	0535745865010	99000	81000	F	1860	1920		
20027	330	0535745865010	88000	72000	F	3100	3100	2490	
20028	330	0535745865010	77000	63000	F	5900	7000	6500	
20029	330	0535745865010	66000	54000	F	16000	20000		
20030	330	0535745865010	55000	45000	F	2112000	42000	56000	44000
					S	2112000			
20031	330	0535745865010	52250	42750	F	38000	136000	4794000	71000
20032	330	0535445865010	50000	50000	F	8000	7000		
20033	330	0535445865010	40000	40000	F	29000	41000		
20034	330	0535445865010	84000	36000	F	7100	7000		
20035	330	0525045969016	41250	33750	F	15210	31940		
20036	330	0525045969016	35750	29250	F	59400	5602630		
20037	330	0510045960010	59500	59500	F	8000	10000		
20038	330	0510045960010	47500	47500	F	20000	22000		
20039	330	0510045960010	41500	41500	F	51000	52000		
20040	330	0510045960010	35500	35500	F	1979000	71000		

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
					S	1979000						
20041	329	0318849065450	0	50000	F	64200	77760	84840				
20042	329	0318849065450	0	40000	F	193920	218160	289800				
20043	329	0318849065450	0	30000	F	739200	748800	765000	766080	939360	1186560	
20044	329	0318849065450	0	25000	F	1770300	1934400	3224520				
20045	329	0318849065450	0	20000	F	2663580	5418000	6605400	15244920	22972320	83604960	
20046	329	0318849065456	0	30000	F	564480	580920	486000	489600			
20047	329	0318849065456	0	20000	F	2711160	3572040	4286520	5011980			
20048	329	0318849065456	0	15000	F	10703880	16670880	23731200				
20049	329	0318849065456	0	13000	F	24382080	29846880					
20050	329	0318849065456	0	25000	F	250260	316800					
20051	329	0318849065456	0	20000	F	564480	609900	733200				
20052	329	0318849065456	0	15000	F	1639440	2611320	2684160	3234000			
20053	329	0318849065456	0	13000	F	3824700	4085640	4752000	10668060			
20054	329	0318849065420	0	70700	F	75600	94500	124800	133320			
20055	329	0318849065420	0	56560	F	151200	190800	310500	474240	605880		
20056	329	0318849065420	0	42420	F	954720	1209600	2919600	3726540	3924300	5436000	5781240
					F	7809120						
20057	329	0318849065420	0	35350	F	4920480	6830640	13128000	16997760	26407800		
20058	329	0318849065420	0	31110	F	107198280	25520400	26994240				
					S	107198280						
20059	329	0318849065426	0	70700	F	63360	69840	87300				
20060	329	0318849065426	0	56560	F	88200	138240	162960	194040			
20061	329	0318849065426	0	42420	F	552960	588000	811440	1018500			
20062	329	0318849065426	0	35350	F	1393920	1958040	2394000				
20063	329	0318849065426	0	28280	F	1411200	2222640	4449060	4839300	68120460	69956400	
20064	329	0318849065426	0	24040	F	109373880	34998480					
					S	109373880						
20065	329	0318849065426	0	56560	F	49140	55800	55800	56400			
20066	329	0318849065426	0	42420	F	117600	129600	144000	184140			
20067	329	0318849065426	0	28280	F	298920	315840	366600	377880	439920		
20068	329	0318849065426	0	25450	F	99335160	70962480					
					S	99335160						
20069	332	0602584872010	122500	122500	F	61	39					
20070	332	0602584872010	109500	109500	F	76	156	111	165			
20071	332	0602584872010	97000	97000	F	363	339	401	349			
20072	332	0602584972010	109500	109500	F	118	102	178				
20073	332	0602584872018	159000	159000	F	29	21	6	37			
20074	332	0602584872018	142500	142500	F	98	81	137	113			
20075	332	0602584872018	125500	125500	F	231	281	285	291			
20076	332	0602584972018	142500	142500	F	53	80	80				

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)					
20077	332	0602584872018	149000	149000	F	33	62	18			
20078	332	0602584872011	109500	109500	F	200	100	100			
20079	332	0602584872011	97000	97000	F	300	300	350	300		
20080	332	0602584972011	109500	109500	F	100	100	150			
20081	332	0002049972010	65000	65000	F	743	557	20	702		
20082	332	0002049972018	75000	75000	F	1204	894	691	773		
20083	332	0002049972018	83000	83000	F	456	437	195	743		
20084	332	0002049972011	65000	65000	F	557	350	615			
20085	338	0008038919010	120000	120000	F	18000	8000				
20086	338	0008038919010	105000	105000	F	15000	37000	24000	26000		
20087	338	0008038919010	126000	84000	F	18000	29000	42000			
20088	338	0008038919010	90000	90000	F	23000	23000	93000	59000	98000	72000
20089	338	0008038919010	108000	72000	F	160000	1982000				
20090	338	0008038919010	80000	80000	F	2480000	65000	25000			
					S	2480000					
20091	338	0008038919010	110000	110000	F	16000	17000				
20092	338	0008038919010	100000	100000	F	32000	38000				
20093	338	0008038919010	80000	80000	F	99000	134000				
20094	338	0025085919010	56000	114000	F	87000	58000				
20095	338	0025085919010	80000	80000	F	50000	119000	53000	153000		
20096	338	0025085919010	0	130000	F	48000	93000				
20097	338	0025085919010	110000	110000	F	2000	3000				
20098	338	0025085919010	56000	134000	F	23000	19000				
20099	338	0025085919010	0	160000	F	4000	7000				
20100	338	0025085919010	70000	70000	F	57000	2625000				
20101	338	0025085919010	0	140000	F	10000	5000				
20102	338	0025038919010	56000	114000	F	16000	20000				
20103	338	0025038919010	80000	80000	F	156000	14000	1077000			
20104	338	0025038919010	70000	70000	F	11985000	3052000	241000			
					S	11985000					
20105	338	0025038919010	56000	80000	F	75000	2741000				
20106	338	0025038919010	56000	128000	F	8000	18000				
20107	338	0025038919010	90000	90000	F	230000	69000				
					S	230000					
20108	338	0025038919010	0	160000	F	18000	26000				
20109	338	0008085919010	120000	120000	F	10000	12000	12000	8000		
20110	338	0008085919010	144000	96000	F	17100	17000				
20111	338	0008085919010	110000	110000	F	48000	12000	1000	19000		
20112	338	0008085919010	132000	88000	F	30000	53000				
20113	338	0008085919010	100000	100000	F	214000	72000				
20114	340	0000085965010	75000	75000	F	3100	3000	3000			

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
20115	340	0000085965010	60000	60000	F	8000	8000	6000				
20116	340	0000085965010	40000	40000	F	25000	18000	19000				
20117	340	0000085965010	25000	25000	F	7742000	262000					
20118	340	0000085865010	75000	75000	F	4000	5000	3000				
20119	340	0000085865010	60000	60000	F	7100	7000	7000				
20120	340	0000085865010	40000	40000	F	22000	31000	39000				
20121	340	0000085865010	30000	30000	F	107000	88000	59000				
20122	340	0012585860010	30000	30000	F	46000	36000					
20123	340	0012585860010	30000	30000	F	108000	40000					
20124	340	0012585860010	30000	30000	F	32000	30000					
20125	337	0000085965010	60000	60000	F	8100	8000					
20126	337	0000085965010	50000	50000	F	11000	17000	12000				
20127	337	0000085965010	36000	36000	F	34000	50000					
20128	337	0000085965010	30000	30000	F	233000	113000					
20129	337	0000085965010	25000	25000	F	469000	179000					
20130	337	0000085865010	40500	94500	F	5000	3000					
20131	337	0000085865010	33000	77000	F	6000	8000					
20132	337	0000085865010	25500	59500	F	13000	15000					
20133	337	0000085865010	18000	42000	F	62000	80000	175000				
20134	337	0000085865010	13500	31500	F	114000	196000					
20135	339	0010038071010	37500	37500	F	19000	45000	20000				
20136	339	0010038071010	42500	42500	F	60000	69000	61000				
20137	339	0010038071010	50000	50000	F	6000	5000	8000	7000	6000	26000	30000
					F	31000	15000	12000	27000	14000	31000	17000
					F	12000	20000	17000	20000	34000	24000	
20138	334	0602585865010	35000	35000	F	1094000	22000					
20139	334	0602585865010	33000	33000	F	37000	316000					
20140	334	0602585865010	80000	80000	F	2000	4000	4000				
20141	334	0602585865010	50000	50000	F	24000	22000	30000				
20142	336	0602585865010	0	40000	F	200000	198000					
20143	336	0602585865010	0	32000	F	374000	229000					
20144	335	0625085865010	80000	80000	F	3100	3000					
20145	335	0625085865010	35000	35000	F	40000	2165000					
20146	335	0625085865010	32000	32000	F	3441000	144000					
					S	3441000						
20147	323	2600085865010	75000	75000	F	4000	5000	3000				
20148	323	2600085865010	60000	60000	F	7100	7000	7000				
20149	323	2600085865010	40000	40000	F	22000	31000	39000				
20150	323	2600085865010	30000	30000	F	107000	88000	59000				
20151	323	2600085965010	75000	75000	F	3100	3000	3000				
20152	323	2600085965010	60000	60000	F	8000	8000	6000				

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA	FAILED (F) OR SUSPENDED (S)	
20153	323	2600085965010	40000	40000	F	25000	18000	19000
20154	323	2600085965010	25000	25000	F	7742000	262000	
20155	323	2600085965010	60000	60000	F	8100	8000	
20156	323	2600085965010	50000	50000	F	11000	17000	12000
20157	323	2600085965010	36000	36000	F	34000	50000	
20158	323	2600085965010	30000	30000	F	233000	113000	
20159	323	2600085965010	25000	25000	F	469000	179000	
20160	323	2600085865010	94500	40500	F	5000	3000	
20161	323	2600085865010	77000	33000	F	8000	6000	
20162	323	2600085865010	59500	25500	F	3000	15000	
20163	323	2600085865010	42000	18000	F	175000	80000	62000
20164	323	2600085865010	31500	13500	F	196000	114000	
20165	319	0405090060010	40000	60000	F	25000	36000	
20166	319	0405090060010	40000	30000	F	125000	135000	
20167	319	0405090060016	40000	30000	F	5000000	10785000	
					S	5000000		
20168	319	0405090060016	40000	60000	F	4000	7000	
20169	319	0405090060016	40000	40000	F	14000	11000	
20170	319	0405090060016	40000	60000	F	5500	5000	
20171	319	0405090019010	27000	53000	F	121000	40000	96000
					S	121000		
20172	319	0405090019016	27000	54000	F	3000	3000	4000
20173	319	0405090019016	27000	40500	F	64000	179000	
20174	319	0405090019016	27000	47200	F	10000	27000	
20175	319	0405090019016	27000	40500	F	231000	242000	
20176	319	0405090019016	27000	54000	F	5100	5000	
20177	319	0405090019016	27000	47200	F	17100	17000	
20178	319	0405090019010	40000	60000	F	65000	153000	
					S	65000	153000	
20179	319	0405090019016	40000	80000	F	5000	8000	
20180	319	0405090019016	40000	60000	F	23000	32000	46000
20181	319	0405090019016	40000	40000	F	3210000	1587000	
20182	319	0405090019016	40000	80000	F	3000	7000	6000
20183	319	0405090019016	40000	60000	F	49000	34000	
20184	319	0405090062010	40000	60000	F	20000	84000	26000
20185	319	0405090062010	40000	40000	F	60000	139000	121000
20186	319	0405090062010	40000	30000	F	211000	184000	
20187	319	0405090062016	40000	60000	F	7000	9000	6000
20188	319	0405090062016	40000	40000	F	25000	16000	
20189	319	0405090062016	40000	30000	F	63000	96000	
20190	319	0405090062016	40000	30000	F	30000	29000	

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
20191	319	0405090029010	40000	40000	F	30000	20000			
20192	319	0405090029010	40000	30000	F	27000	33000			
20193	319	0405090029010	40000	20000	F	43000	32000			
20194	319	0405090029010	40000	10000	F	291000	430000			
20195	319	0405090029016	40000	40000	F	11000	10000			
20196	319	0405090029016	40000	20000	F	25000	22000			
20197	319	0405090029016	40000	60000	F	3100	3000			
20198	319	0405090023010	40000	40000	F	14000	21000			
20199	319	0405090023010	40000	50000	F	1000	400			
20200	319	0405090023010	40000	30000	F	42000	221000			
20201	319	0405090023016	40000	40000	F	15000	7000			
20202	319	0405090023016	40000	30000	F	16000	63000			
20203	319	0405090023016	40000	40000	F	5100	5000			
20204	319	0405090023016	40000	20000	F	89000	22000			
20205	319	0405090023016	40000	30000	F	14000	18000			
20206	327	0402524819010	75000	75000	F	987	898	968	643	814
20207	327	0402524819010	85000	85000	F	581	498	599	516	528
20208	327	0402524819010	95000	95000	F	423	393	402	406	474
20209	327	0402524819010	85000	85000	F	560	651	649	604	487
20210	327	0402524929010	66000	66000	F	460	365	398	393	411
20211	327	0402524929010	75000	75000	F	212	273	323	601	422
20212	327	0402524929010	85000	85000	F	443	296	439	254	302
20213	327	0402524819018	94500	94500	F	1155	1154	997	855	982
20214	327	0402524819018	107000	107000	F	530	418	376	357	350
20215	327	0402524819018	119500	119500	F	84	68	58	129	32
20216	327	0402524819018	107000	107000	F	281	156	103	54	140
20217	327	0402524929018	94500	94500	F	246	388	298	307	80
20218	327	0402524929018	107000	107000	F	41	2	21	5	3
20219	327	0402524929018	82500	82500	F	917	669	766	984	555
20220	327	0402524819018	78500	78500	F	50	40	140	105	28
20221	327	0402524819018	89000	89000	F	39	38	117	21	51
20222	327	0402524819018	99500	99500	F	6	5	3	4	3
20223	327	0402524819018	89000	89000	F	19	16	13	16	19
20224	327	0402524929018	61500	61500	F	72	28	115	106	72
20225	327	0402524929018	69500	69500	F	25	7	10	12	57
20226	327	0402524929018	78000	78000	F	4	2	3	3	5
20227	327	0402524819011	75000	75000	F	600	465	500	300	500
20228	327	0402524819011	85000	85000	F	400	429	350	350	350
20229	327	0402524819011	95000	95000	F	300	250	300	300	350
20230	327	0402524819011	85000	85000	F	400	400	450	300	300
20231	327	0402524929019	66000	66000	F	377	350	350	350	

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
20232	327	0402524929019	75000	75000	F	150	223	490	400	
20233	327	0603294819010	118000	118000	F	109	164	134	144	144
20234	327	0603294819010	118000	118000	F	133	107	134	144	132
20235	327	0603294929010	106500	106500	F	10	38	24	5	33
20236	327	0603294819018	63000	63000	F	3	4	7	4	
20237	327	0603294819018	56000	56000	F	19	31	71	11	
20238	327	0603294929018	47000	47000	F	15	72	55	29	51
20239	327	0603294819018	42500	42500	F	20	7	30	30	7
20240	327	0603294819018	38500	38500	F	84	208	184	227	70
20241	327	0603294929018	27500	27500	F	393	309	562	7	17
20242	327	0603294819011	118000	118000	F	200	100	100	100	100
20243	327	0603294819011	118000	118000	F	77	50	50	50	72
20244	311	0207536065810	0	125000	F	6	8			
20245	311	0207536065810	0	120000	F	14	15	19		
20246	311	0207536065810	0	100000	F	142	190	205		
20247	311	0207536065810	0	80000	F	963	1075	1106		
20248	311	0207536065810	0	58000	F	4504	5779			
20249	311	0207536065810	0	50000	F	9832	9970			
20250	311	0207536065810	0	50000	F	27000	35000			
20251	311	0207536065810	0	50000	F	12000	39000			
20252	311	0207536065810	0	45000	F	43000	45700			
20253	311	0207536065810	20000	108000	F	3	2	2		
20254	311	0207536065810	20000	105000	F	6	7	12		
20255	311	0207536065810	20000	100000	F	38	50	58		
20256	311	0207536065810	20000	90000	F	275	297	330		
20257	311	0207536065810	20000	70000	F	1522	1855	1868	1954	
20258	311	0207536065810	20000	53000	F	6376	7350			
20259	311	0207536065810	20000	50000	F	24500	28000			
20260	311	0207536065810	20000	45000	F	20000	33000			
20261	311	0207536065810	20000	27500	F	290000	464000			
20262	311	0207536065810	0	124000	F	5	4			
20263	311	0207536065810	0	120000	F	5	6			
20264	311	0207536065810	0	110000	F	13	14			
20265	311	0207536065810	0	90000	F	104	106			
20266	311	0207536065810	0	65000	F	589	682	874		
20267	311	0207536065810	0	42500	F	5400	14800			
20268	311	0207536065810	20000	105000	F	5	5	7		
20269	311	0207536065810	20000	80000	F	116	152	157	158	
20270	311	0207536065810	20000	60000	F	496	625	898		
20271	311	0207536065810	20000	37500	F	4711	5847	6486		
20272	311	0207536065810	20000	31000	F	16000	19000			

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
20273	311	0207536065810	20000	15000	F	164000	181000	202000				
20274	311	0307536065810	0	190000	F	4	9					
20275	311	0307536065810	0	186000	F	3	7	7	10			
20276	311	0307536065810	0	160000	F	83	86	93	111			
20277	311	0307536065810	0	140000	F	183	212	240				
20278	311	0307536065810	0	120000	F	421	449	513				
20279	311	0307536065810	0	100000	F	916	926	1048				
20280	311	0307536065810	0	80000	F	2908	3514					
20281	311	0307536065810	0	60000	F	12551	18921					
20282	311	0307536065810	50000	143000	F	12	15	23				
20283	311	0307536065810	50000	130000	F	161	186	191				
20284	311	0307536065810	50000	110000	F	473	479	539				
20285	311	0307536065810	50000	80000	F	1727	1843	2133				
20286	311	0307536065810	50000	60000	F	5176	6522					
20287	311	0307536065810	50000	40000	F	28000	36000					
20288	311	0307536065810	50000	30000	F	40085	88000					
20289	311	0307536065810	0	190000	F	2	3					
20290	311	0307536065810	0	180000	F	20	10	10				
20291	311	0307536065810	0	160000	F	17	25	25				
20292	311	0307536065810	0	140000	F	43	59	60				
20293	311	0307536065810	0	120000	F	110	115	135				
20294	311	0307536065810	0	100000	F	253	296					
20295	311	0307536065810	0	80000	F	922	1300	1338				
20296	311	0307536065810	0	30000	F	81000	104000					
20297	311	0307536065810	50000	135000	F	13	21	25				
20298	311	0307536065810	50000	110000	F	91	99	101				
20299	311	0307536065810	50000	90000	F	242	287	319				
20300	311	0307536065810	50000	70000	F	776	811	819				
20301	311	0307536065810	50000	50000	F	2440	3074	3303				
20302	311	0307536065810	50000	20000	F	70000	125000					
20303	320	0400092865010	40000	22000	F	41000	45000	78000	94000			
20304	320	0400092812010	40000	35000	F	19000	20000	21000	27000			
20305	320	0400092812010	40000	15000	F	242000	25000	252000				
20306	320	0400092812010	40000	10000	F	810000	2586000					
20307	320	0400092819010	40000	65000	F	20000	22000	33000				
20308	320	0400092819010	40000	62000	F	21000	72000					
20309	320	0400092819010	40000	60000	F	36000	42000	49000				
20310	320	0400092819010	40000	55000	F	44000	50000	60000				
20311	320	0400092819010	40000	50000	F	24000	68000	115000	120000	129000	130000	170000
					F	171000	184000	328000	355000			
20312	320	0400092819010	40000	47000	F	127000	215000	369000				

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
20313	320	0400092819010	40000	45000	F	329000	1065000			
20314	320	0400092819010	40000	39000	F	2233000	8140000			
20315	320	0400092819010	40000	75000	F	26000	32000	70000		
20316	320	0400092819010	40000	70000	F	20000	57000	89000	93000	
20317	320	0400092819010	40000	65000	F	47000	52000	61000	261000	
20318	320	0400092819010	40000	60000	F	80000	85000	97000	129000	220000
20319	320	0400092819010	40000	55000	F	275000	337000	728000		
20320	320	0400092819010	40000	52000	F	206000	257000	314000		
20321	320	0400092819010	40000	50000	F	10000000	108000	198000	223000	574000
					S	10000000				
20322	320	0400092819010	40000	47000	F	10000000	1352000			
					S	10000000				
20323	320	0400090865010	40000	45000	F	11100	11000	11000		
20324	320	0400090865010	40000	40000	F	16000	16000	22000		
20325	320	0400090865010	40000	32000	F	23000	23000	28000		
20326	320	0400090865010	40000	25000	F	38000	41000	49000	53000	62000
20327	320	0400090865010	40000	20000	F	67000	67000	94000		
20328	320	0400090865010	40000	18000	F	10000000	87000			
					S	10000000				
20329	320	0400090865010	40000	17000	F	84000	1245000	1792000		
20330	320	0400090865010	40000	15000	F	110000	174000	1026000	1862000	
20331	320	0400090812010	40000	35000	F	24000	26000	30000	39000	
20332	320	0400090812010	40000	30000	F	43000	56000			
20333	320	0400090812010	40000	25000	F	87000	88000	88000	91000	98000
20334	320	0400090812010	40000	20000	F	191000	240000	249000	250000	
20335	320	0400090812010	40000	15000	F	429000	510000	610000	643000	844000
20336	320	0400090812010	40000	13000	F	830000	1296000			
20337	320	0400090812010	40000	11000	F	300000	1590000			
					S	300000				
20338	320	0400090819010	40000	75000	F	16000	17000	20000		
20339	320	0400090819010	40000	70000	F	21000	32000	33000		
20340	320	0400090819010	40000	65000	F	52000	59000	59000		
20341	320	0400090819010	40000	60000	F	131000	141000	163000	180000	204000
20342	320	0400090819010	40000	55000	F	239000	261000	677000		
20343	320	0400090819010	40000	52000	F	141000	1764000	2895000		
20344	320	0400090819010	40000	50000	F	379000	959000	1315000	3220000	
20345	320	0300090865010	40000	40000	F	9000	10000	14000		
20346	320	0300090865010	40000	35000	F	14000	18000	20000		
20347	320	0300090865010	40000	32000	F	20000	25000	38000		
20348	320	0300090865010	40000	28000	F	22000	25000	49000		
20349	320	0300090865010	40000	25000	F	47000	54000	87000		

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	STRESSES ALT.		DATA - FAILED (F) OR SUSPENDED (S)					
20350	320	0300090865010	40000	22000	F	71000	85000	9141000			
20351	320	0300090812010	40000	35000	F	18000	24000	21000			
20352	320	0300090812010	40000	30000	F	34000	38000	43000	47000		
20353	320	0300090812010	40000	25000	F	71000	83000	86000			
20354	320	0300090812010	40000	20000	F	111000	159000	176000	231000		
20355	320	0300090812010	40000	17000	F	255000	273000	289000	326000		
20356	320	0300090812010	40000	15000	F	10000000	330000	960000			
					S	10000000					
20357	320	0300090812010	40000	12000	F	3489000	4554000	8089000			
20358	320	0300090812010	40000	11000	F	1942000	2112000				
20359	320	0300090819010	40000	85000	F	5000	8000				
20360	320	0300090819010	40000	80000	F	8000	9000	11000			
20361	320	0300090819010	40000	75000	F	12000	13000	25000			
20362	320	0300090819010	40000	70000	F	20000	33000	47000			
20363	320	0300090819010	40000	65000	F	69000	70000	71000	137000		
20364	320	0300090819010	40000	60000	F	75000	154000	159000	180000	188000	275000
20365	320	0300090819010	40000	57000	F	75000	246000	251000	278000		
20366	320	0300090819010	40000	55000	F	136000	457000	524000	550000	738000	
20367	320	0300090819010	40000	52000	F	306000	383000	700000			
20368	320	0300090819010	40000	50000	F	10000000	994000	1293000	1590000		
					S	10000000					
20369	320	0300090819010	40000	100000	F	11000	25000	26000	29000		
20370	320	0300090819010	40000	90000	F	27000	30000	32000	34000	35000	
20371	320	0300090819010	40000	85000	F	44000	117000				
20372	320	0300090819010	40000	80000	F	45000	49000	62000	89000		
20373	320	0300090819010	40000	75000	F	107000	154000	202000			
20374	320	0300090819010	40000	70000	F	135000	141000	238000			
20375	320	0300090819010	40000	65000	F	334000	366000				
20376	320	0300090819010	40000	60000	F	151000	366000	487000			
20377	320	0300090819010	40000	57000	F	787000	2823000				
20378	320	0400024865010	40000	30000	F	17000	18000	21000			
20379	320	0400024865010	40000	25000	F	20000	28000	30000			
20380	320	0400024865010	40000	20000	F	10000000	52000	59000			
					S	10000000					
20381	320	0400024865010	40000	170000	F	10000000	10000000	10000000			
					S	10000000	10000000	10000000			
20382	320	0400024865010	40000	15000	F	94000	108000	271000	425000	9879000	
20383	320	0400024865010	40000	12000	F	10000000	630000	5265000			
					S	10000000					
20384	320	0400024865010	40000	10000	F	10000000	7904000				
					S	10000000					

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
20385	320	0400024812010	40000	30000	F	18000	19000	19000		
20386	320	0400024812010	40000	25000	F	30000	32000	36000	54000	
20387	320	0400024812010	40000	20000	F	71000	71000	76000	125000	
20388	320	0400024812010	40000	17000	F	110000	126000	145000		
20389	320	0400024812010	40000	15000	F	137000	167000	186000	332000	
20390	320	0400024812010	40000	13000	F	256000	257000	294000		
20391	320	0400024812010	40000	12000	F	10000000	387000	437000		
					S	10000000				
20392	320	0400024812010	40000	11000	F	387000	422000	608000		
20393	320	0400024812010	40000	10000	F	695000	777000			
20394	320	0400024819010	40000	47000	F	61000	66000	115000		
20395	320	0400024819010	40000	45000	F	39000	48000	103000		
20396	320	0400024819010	40000	43000	F	309000	312000	573000		
20397	320	0400024819010	40000	42000	F	10000000	108000	9991000		
					S	10000000				
20398	320	0400024819010	40000	40000	F	10000000	10000000			
					S	10000000	10000000			
20399	320	0400092865016	40000	22000	F	47000	49000	66000	67000	69000
20400	320	0400092865016	40000	22000	F	36000	45000	47000	58000	155000
20401	320	0400092865016	40000	22000	F	43000	46000	54000	54000	74000
20402	320	0400092812016	40000	27000	F	46000	48000	51000	64000	72000
20403	320	0400092812016	40000	27000	F	59000	59000	68000	69000	98000
20404	320	0400092812016	40000	27000	F	74000	79000	101000	107000	111000
20405	320	0400092819016	40000	50000	F	173000	174000	196000	239000	260000
20406	320	0400092819016	40000	60000	F	74000	86000	90000	100000	180000
20407	320	0400092819016	40000	60000	F	54000	58000	63000	133000	263000
20408	320	0400090865016	40000	25000	F	38000	41000	44000	48000	7690000
20409	320	0400090865016	40000	25000	F	36000	43000	45000	50000	6629000
20410	320	0400090865016	40000	25000	F	32000	37000	38000	39000	43000
20411	320	0400090812016	40000	15000	F	579000	652000	695000	1233000	1795000
20412	320	0400090812016	40000	15000	F	687000	803000	884000	1312000	1547000
20413	320	0400090812016	40000	15000	F	620000	690000	817000	1161000	1666000
20414	320	0400090819016	40000	60000	F	72000	90000	111000	118000	155000
20415	320	0400090819016	40000	60000	F	65000	69000	85000	87000	90000
20416	320	0300090865016	40000	25000	F	22000	33000	39000	63000	132000
20417	320	0300090865016	40000	25000	F	35000	36000	38000	50000	88000
20418	320	0300090865016	40000	25000	F	22000	25000	26000	30000	33000
20419	320	0300090812016	40000	17000	F	227000	263000	306000	322000	
20420	320	0300090812016	40000	17000	F	217000	262000	277000	329000	392000
20421	320	0300090812016	40000	17000	F	249000	298000	329000	339000	375000
20422	320	0300090819016	40000	60000	F	40000	49000	64000	81000	117000

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
20423	320	0300090819016	40000	60000	F	30000	36000	43000	47000	55000
20424	320	0300090819016	40000	75000	F	81000	96000	116000	196000	228000
20425	320	0300090819016	40000	75000	F	61000	72000	85000	125000	129000
20426	320	0400024865016	40000	20000	F	15000000	38000	48000	66000	
					S	15000000				
20427	320	0400024865016	40000	20000	F	10230000	10446000	62000		
					S	10230000	10446000			
20428	320	0400024865016	40000	20000	F	38000	46000	53000	2036000	6828000
20429	320	0400024812016	40000	17000	F	115000	120000	126000	128000	129000
20430	320	0400024812016	40000	17000	F	106000	125000	134000	135000	155000
20431	320	0400024812016	40000	17000	F	108000	113000	125000	130000	134000
20432	320	0400024819016	40000	42000	F	61000	93000	129000	143000	
20433	320	0400024819016	40000	42000	F	68000	92000	115000	134000	141000
20434	313	0635785865010	93500	76500	F	6000	7000			
20435	313	0635785865010	77000	63000	F	12000	10000			
20436	313	0635785865010	66000	54000	F	22000	40000			
20437	313	0635785865010	55000	45000	F	84000	65000			
20438	313	0635785865010	49500	40500	F	9855000	390000	152000		
20439	313	0635785865010	44000	36000	F	10647000	872000			
					S	10647000				
20440	313	0535785965010	44000	36000	F	68000	49000			
20441	313	0535785965010	38500	31500	F	690000	106000			
20442	313	0635785865010	77000	63000	F	10000	16000			
20443	313	0635785865010	66000	54000	F	29000	26000			
20444	313	0635785865010	55000	45000	F	34000	48000			
20445	313	0635785865010	49500	40500	F	75000	371000			
20446	313	0635785865010	44000	36000	F	6667000	84000	378000		
20447	313	0635785965010	66000	54000	F	7000	12000			
20448	313	0635785965010	44000	36000	F	44000	56000			
20449	313	0635785965010	38500	31500	F	2090000	201000			
20450	313	0643085865010	71500	58500	F	22000	25000			
20451	313	0643085865010	55000	45000	F	55000	76000			
20452	313	0643085865010	49500	40500	F	121000	131000			
20453	313	0643085965010	66000	54000	F	15000	13000			
20454	313	0643085965010	60500	49500	F	29000	28000			
20455	313	0643085965010	44000	36000	F	154000	333000	129000		
20456	313	0643085965010	38500	31500	F	7109000	6047000			
					S	7109000				
20457	313	0543085865010	71500	58500	F	12000	13000			
20458	313	0543085865010	63250	51750	F	19000	22000			
20459	313	0543085865010	55000	45000	F	28000	29000			

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)					
20460	313	0543085865010	38500	31500	F	298000	167000				
20461	313	0543085865010	35750	29250	F	251000	4686000				
20462	313	0643085965010	71500	58500	F	13000	11000				
20463	313	0643085965010	63250	51750	F	19000	32000				
20464	313	0643085965010	55000	45000	F	27000	305000				
20465	313	0643085965010	46750	38250	F	116000	54000				
20466	313	0543041965010	77000	63000	F	23000	33000				
20467	313	0543041965010	70125	57375	F	19000	13000				
20468	313	0543041965010	66000	54000	F	1106000	3528000	55000	42000	30000	
20469	313	0543041965010	55000	45000	F	9614000	3270000	2026000	29000		
					S	9614000					
20470	313	0543041965010	52250	42750	F	10176000	754000				
					S	10176000					
20471	313	0543041965010	49500	40500	F	52000	12036000				
20472	313	0500041965010	77000	63000	F	5000	19000	5000			
20473	313	0500041965010	71500	58500	F	40000	4000				
20474	313	0500041965010	66000	54000	F	24000	18000				
20475	313	0500041965010	60500	49500	F	19000	2679000	74000	29000	866000	
20476	313	0500041965010	55000	45000	F	197000	308000	32000			
20477	313	0500041965010	49500	40500	F	844000	37000	131000	11055000	243000	15000000
20478	313	0400041965010	60500	49500	F	21000	19000	17000	21000		
20479	313	0400041965010	55000	45000	F	28000	53000	40000	32000		
20480	313	0400041965010	49500	40500	F	64000	80000	42000	42000		
20481	313	0400041965010	44000	36000	F	10032000	5000000	64000	73000		
					S	10032000	5000000				
20482	313	0400041965010	42900	35100	F	10062000	197000				
					S	10062000					
20483	313	0631585865010	125000	125000	F	797	1152				
20484	313	0531585965310	170000	170000	F	22	37				
20485	313	0531585965010	170000	170000	F	39	24	45			
20486	313	0531585965310	155000	155000	F	33	119				
20487	313	0531585965010	155000	155000	F	205	105				
20488	313	0531585965010	125000	125000	F	442	342				
20489	313	0631585865310	170000	170000	F	100	106				
20490	313	0631585865010	170000	170000	F	162	195	153			
20491	313	0631585965310	170000	170000	F	23	21				
20492	313	0631585965010	170000	170000	F	19	14	21			
20493	313	0631585965010	155000	155000	F	42	59				
20494	313	0631585965010	125000	125000	F	221	299				
20495	313	0631585865310	170000	170000	F	130	75				
20496	313	0631585865310	170000	170000	F	124	71				

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
20497	313	0631585865010	170000	170000	F	187	141			
20498	313	0631585865310	155000	155000	F	306	175	242		
20499	313	0631585865010	155000	155000	F	218	202			
20500	313	0631585965310	170000	170000	F	37	53			
20501	313	0631585965310	170000	170000	F	56	1			
20502	313	0631585965010	170000	170000	F	36	35			
20503	305	2522140865410	70000	70000	F	2490	7100			
20504	305	2522140865410	0	100000	F	1884	7900			
20505	305	2522140865410	0	70000	F	5636	25300			
20506	305	2522140865416	50000	50000	F	17506	13700	23400		
20507	305	2522140865416	150000	150000	F	73	84			
20508	305	2522140865416	50000	50000	F	13112	20000			
20509	305	2522140855416	45000	45000	F	23300	39500			
20510	305	2522140865416	40000	40000	F	79900	163000			
20511	305	2522140865416	0	55000	F	37000	59400			
20512	308	0403791860410	0	140000	F	67	91			
20513	308	0403791860410	0	120000	F	191	206			
20514	308	0403791860410	0	100000	F	647	692			
20515	308	0403791860410	0	80000	F	826	1209	2221		
20516	308	0403791860410	0	70000	F	3664	6670			
20517	308	0403791860410	0	60000	F	74610	85760			
20518	308	0403791860410	0	40000	F	1516000	1664000	41837000		
20519	308	0403791865410	0	80000	F	179	258			
20520	308	0403791865410	0	60000	F	608	1041			
20521	308	0403791865410	0	50000	F	2279	3796			
20522	308	0403791865410	0	40000	F	7392	11172			
20523	308	0403791865410	0	20000	F	1492000	1750000			
20524	308	0403791865410	0	100000	F	70	75			
20525	308	0403791865410	0	80000	F	249	289			
20526	308	0403791865410	0	60000	F	1432	1972			
20527	308	0403791865410	0	30000	F	166000	213000			
20528	308	0403791865410	0	23000	F	10181000	17904000			
20529	310	0402592065410	0	80000	F	270	330	430		
20530	310	0402592065410	0	70000	F	500	652	665	764	940
20531	310	0402592065410	0	60000	F	1258	2000	5012		
20532	310	0402592065410	0	50000	F	7570	8280	9320		
20533	310	0402592065410	0	50000	F	14000	15000	16000		
20534	310	0402592065410	0	40000	F	37590	44170			
20535	310	0402592065410	0	40000	F	58000	91000	111000		
20536	310	0402592065410	0	35000	F	162000	232000			
20537	310	0402592065410	0	30000	F	258000	854000	2342000	5187000	

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)			
20538	310	0402592065410	33500	76500	F	180	240	250	
20539	310	0402592065410	33500	66500	F	547	560	560	617
20540	310	0402592065410	33500	56500	F	1000	1100	1100	
20541	310	0402592065410	33500	46500	F	1200	2500	2800	
20542	310	0402592065410	33500	41500	F	5170	7360		
20543	310	0402592065410	33500	41500	F	10000	11000		
20544	310	0402592065410	33500	36500	F	27000	31000	36000	
20545	310	0402592065410	33500	26500	F	49000	103000		
20546	310	0402592065410	33500	26500	F	55000	65000	67000	
20547	310	0402592065410	33500	24500	F	85000	94000	210000	
20548	310	0402592065410	33500	21500	F	4391000	4732000	7616000	
20549	310	0402592065416	67000	63000	F	238	251		
20550	310	0402592065416	67000	53000	F	390	420	900	
20551	310	0402592065416	67000	43000	F	1900	2000	2500	
20552	310	0402592065416	67000	33000	F	3900	4100	5000	
20553	310	0402592065416	67000	23000	F	12000	14000	14000	
20554	310	0402592065410	67000	73000	F	306	336	337	
20555	310	0402592065410	67000	63000	F	480	620	630	780
20556	310	0402592065410	67000	53000	F	1150	1230	1500	
20557	310	0402592065410	67000	43000	F	2010	2940	3110	
20558	310	0402592065410	67000	33000	F	9000	11000	11000	
20559	310	0402592065410	67000	33000	F	10170	20600		
20560	310	0402592065410	67000	23000	F	14000	26000	30000	32000
20561	310	0402592065410	67000	18000	F	60000	67000	84000	602000
20562	310	0402592065416	0	80000	F	142	200	221	
20563	310	0402592065416	0	70000	F	112	177	245	380
20564	310	0402592065416	0	60000	F	1200	1600	1800	2400
20565	310	0402592065416	0	50000	F	3700	4100	6800	
20566	310	0402592065416	0	40000	F	23000	25000	48000	
20567	310	0402592065416	0	35000	F	54000	64000		
20568	310	0402592065416	0	30000	F	10000000	3727000		
					S	10000000			
20569	310	0402592065416	33500	66500	F	255	300	315	
20570	310	0402592065416	33500	56500	F	600	800	800	900
20571	310	0402592065416	33500	46500	F	1200	1600	2400	
20572	310	0402592065416	33500	36500	F	4500	4900		
20573	310	0402592065416	33500	31500	F	10000	13000		
20574	310	0402592065416	33500	28500	F	10700000	26000		
					S	10700000			
20575	310	0402592065416	33500	26500	F	10000000	1020000		
					S	10000000			

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)			
20576	307	0522140865416	50000	50000	F	13700	23400		
20577	307	0522140865416	45000	45000	F	23300	39500		
20578	307	0522140865416	40000	40000	F	163000	79900		
20579	307	0522140865416	0	55000	F	37000	59400		
20580	306	2535438865410	56000	67200	F	43000	55000		
20581	306	2535438865410	56000	135800	F	7000	10000		
20582	306	2535438865410	56000	89600	F	258000	93000	21000	
20583	306	2535438865410	0	92400	F	6000	9000	8000	
20584	306	2535438865410	0	134500	F	15000	16000		
20585	306	2535438865410	56000	135800	F	7000	8000		
20586	306	2535438865410	0	101000	F	8000	10000		
20587	306	2535438865410	0	67200	F	34100	34000		
20588	306	2535438865410	0	159000	F	6000	3000		
20589	306	1535438865410	0	159500	F	6000	5000	5000	
20590	306	1535438865410	0	134500	F	15000	11000	8000	
20591	306	1535433865410	0	112000	F	148000	51000		
20592	306	1535438865410	0	98000	F	328000	654000	252000	
20593	306	1535438865410	0	14000	F	3000	3000	2000	
20594	306	1535438865410	0	108000	F	17000	16000	14000	
20595	306	1535438865410	0	72800	F	3074000	280000	1167000	
					S	3074000			
20596	306	2535438865410	0	140000	F	3000	2000		
20597	306	2535438865410	0	72800	F	1676000	1736000		
20598	306	2535438965410	0	159500	F	4000	3000		
20599	306	2535438965410	0	128900	F	14000	14000	8000	
20600	306	2535438965410	0	100800	F	132000	106000	76000	
20601	306	2535438965410	0	95000	F	195000	164000		
20602	306	2535438965410	0	140000	F	3000	2000	2000	
20603	306	2535438965410	0	100000	F	15000	8000		
20604	306	2535438965410	0	84000	F	65000	49000	35000	
20605	306	2535438965410	0	61600	F	5292000	1013000	836000	
20606	306	2535438865410	56000	47600	F	9489000	238000		
					S	9489000			
20607	306	1535438965410	0	159500	F	2100	2000		
20608	306	1535438965410	0	128900	F	10000	10000	7000	
20609	306	1535438965410	0	100800	F	750000	112000	99000	51000
20610	306	1535438965410	0	140000	F	2100	2000		
20611	306	1535438965410	0	84000	F	21000	10000	7000	
20612	306	1535436965410	0	61600	F	3688000	106000	67000	14000
20613	306	2535438865410	0	159500	F	1100	1000		
20614	306	2535438865410	0	67200	F	77000	83000		

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
20615	317	0404092865410	50000	30000	F	21000	27000					
20616	317	0404092865410	43750	26250	F	93000	25000					
20617	317	0404092865410	37500	22500	F	240000	83000					
20618	317	0404092965410	50000	30000	F	13000	20000					
20619	317	0404092965410	43750	26250	F	19000	31000					
20620	317	0404092965410	37500	22500	F	240000	378000					
20621	317	0403694865010	46875	28125	F	21000	46000					
20622	317	0403694865010	43750	26250	F	49000	54000					
20623	317	0403694965010	50000	30000	F	24000	31000					
20624	325	0207536065810	0	45000	F	3000	5400					
20625	322	0405090965010	40000	20000	F	99400	119100					
20626	322	0405090965010	100000	35000	F	11700	13700					
20627	318	0400090865416	40000	25000	F	2281000	39000					
20628	318	0400090865416	40000	23700	F	1107000	35000					
20629	312	0000047065010	0	26000	F	2053000	1686000					
20630	312	0000047065016	27000	27000	F	335000	12000					
20631	312	0000047065016	36000	9000	F	3045000	2925000					
20632	328	2302049819010	56500	56500	F	2000	2000					
					S	2000	2000	2000				
20633	328	2302049819010	64000	64000	F	1707	1591	1112	1683	863		
20634	328	2302049819010	71500	71500	F	1127	859	836				
20635	328	2302049819018	66500	66500	F	2000	1917	1519	1918			
					S	2000						
20636	328	2302049819018	75500	75500	F	866	1196	940	919	911		
20637	328	2302049819018	84500	84500	F	1001	726	691	842	751		
20638	328	2302049819018	72000	72000	F	1420	1575	1575	1393	1614		
20639	328	2302049819018	81500	81500	F	715	1024	1096	1442	1160		
20640	328	2302049819018	91000	91000	F	41	678	341	721	736		
20641	328	2302049819011	56500	56500	F	1150	1700	1500	1900			
20642	328	2302049819011	64000	64000	F	1650	1450	1500	500			
20643	341	0312536019010	60308	49342	F	48000	15000	45000	22000	12000	29000	9000
					F	37000						
20644	341	0312536019010	40205	32895	F	647000	307000	104000	314000	751000	122000	22000
					F	196000						
20645	341	0312536019010	30154	24671	F	10000000	5964000	1440000	379000	734000	583000	1085000
					S	10000000						
20646	341	0312536019010	61820	50580	F	56000	60000	70000	61000	53000	50000	26000
					F	38000						
20647	341	0312536019010	41195	33705	F	1448000	241000	924000	841000	308000	237000	150000
					F	438000						
20648	341	0312536019010	30910	25290	F	12878000	10000000	10000000				

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	STRESSES ALT.	DATA - FAILED (F) OR SUSPENDED (S)							
					S	12878000	10000000	10000000	6645000	3452000		
20649	341	0312536049010	61991	50719	F	50000	89000	29000	67000	46000	33000	23000
					F	30000						
20650	341	0312536049010	41327	33813	F	32000	79000	731000	60000	111000	284000	253000
					F	203000						
20651	341	0312536049010	31020	25380	F	11653000	659000	1051000	591000	352000	596000	339000
					S	11653000						
20652	341	0312536049010	61578	50382	F	30000	82000	45000	22000	69000	130000	96000
					F	12000						
20653	341	0312536049010	41052	33588	F	425000	55000	308000	228000	365000	377000	426000
					F	182000						
20654	341	0312536049010	30789	25191	F	15667000	4654000					
					S	15667000	4654000	10238000	10000000	15000000		
20655	341	0312536019010	61825	50585	F	56000	60000	73000	61000	53000	50000	26000
					F	38000						
20656	341	0312536019010	60308	49342	F	48000	15000	45000	22000	12000	29000	9000
					F	37000						
20657	341	0312536049010	61991	50719	F	50000	89000	29000	67000	46000	33000	23000
					F	30000						
20658	341	0312536049010	61578	50382	F	30000	82000	45000	22000	69000	130000	96000
					F	12000						
20659	301	0337548065416	0	29000	F	224600	196000					
20660	315	0130835869010	0	24136	F	4400	5000	5200	5300	5500	5500	6000
					F	6000	6300	6400	6800	7000	7000	7000
					F	7000	7500	7500	8000	8000	8000	8000
					F	8000	8000	8100	8500	8500	9000	9000
					F	9000	9000	9000	9000	9000	9100	9200
					F	9400	9500	9500	9600	9600	9600	9800
					F	9900	10000	10000	10000	10000	10000	10000
					F	10000	10000	10200	10300	10500	10500	10500
					F	10700	10800	10800	11000	11000	11000	11000
					F	11000	11000	11200	11200	11500	11500	11600
					F	11700	11800	12000	12000	12000	12000	12000
					F	12000	12000	12100	12300	12300	12400	12500
					F	12500	13000	13000	13000	13000	13200	13300
					F	13500	13900	14000	14000	14100	16000	16200
					F	17000						
20661	315	0130835869010	0	18102	F	18000	19000	19000	19000	20000	20000	21000
					F	21000	21000	21000	22000	24000	24000	24000
					F	25000	25000	25000	25000	26000	26000	26000
					F	26000	26000	26000	27000	27000	27000	27000

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.	DATA - FAILED (F) OR SUSPENDED (S)							
					F	27000	27000	28000	28000	28000	28000	28000
					F	28000	28000	29000	29000	29000	30000	30000
					F	30000	30000	30000	30000	31000	31000	31000
					F	31000	32000	32000	33000	33000	34000	34000
					F	34000	34000	34000	34000	34000	35000	35000
					F	35000	35000	36000	36000	36000	36000	36000
					F	37000	37000	37000	38000	38000	38000	38000
					F	39000	39000	39000	39000	39000	40000	40000
					F	40000	40000	40000	41000	42000	45000	45000
					F	47000	47000	49000	50000	53000	53000	53000
					F	60000						
20662	315	0130835869010	0	12068	F	77000	78000	80000	82000	84000	86000	87000
					F	88000	91000	97000	100000	102000	102000	102000
					F	102000	104000	105000	106000	106000	108000	109000
					F	109000	111000	111000	115000	115000	116000	117000
					F	117000	118000	119000	119000	119000	121000	121000
					F	122000	123000	123000	123000	123000	123000	124000
					F	125000	125000	126000	127000	127000	127000	128000
					F	128000	128000	129000	131000	131000	136000	137000
					F	138000	139000	140000	140000	140000	141000	142000
					F	143000	145000	146000	147000	147000	147000	149000
					F	151000	152000	154000	154000	156000	156000	157000
					F	157000	162000	166000	166000	171000	174000	176000
					F	177000	181000	181000	181000	187000	189000	190000
					F	193000	198000	198000	200000	200000	209000	224000
					F	234000						
20663	315	0130835869010	0	7543	F	322000	332000	342000	352000	388000	397000	399000
					F	427000	430000	438000	439000	449000	463000	466000
					F	467000	467000	469000	477000	482000	482000	493000
					F	496000	497000	511000	512000	518000	523000	533000
					F	544000	557000	560000	561000	562000	564000	569000
					F	571000	591000	593000	593000	601000	610000	614000
					F	621000	626000	630000	631000	640000	642000	647000
					F	651000	654000	659000	667000	675000	685000	689000
					F	700000	708000	709000	714000	718000	722000	740000
					F	746000	754000	755000	766000	767000	769000	769000
					F	771000	772000	773000	775000	787000	790000	794000
					F	796000	797000	802000	816000	825000	834000	840000
					F	848000	872000	881000	885000	894000	900000	905000
					F	909000	924000	938000	944000	961000	977000	1051000
					F	1096000	1170000	1256000	1347000	1353000	1670000	1715000

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	STRESSES ALT.	DATA - FAILED (F) OR SUSPENDED (S)							
					F	1913000	2094000	3064000	24045000	35523000		
20664	315	0130835869010	0	6034	F	37332000	1181000	1855000	2006000	2130000	2312000	2784000
					F	4787000	73362000					
					S	37332000						
20665	326	0200038869010	39600	32400	F	56000	84000	90000	96000	122000	123000	125000
					F	167000	172000	192000	256000			
20666	326	0200038869010	39600	32400	F	79000	80000	86000	100000	102000	104000	115000
					F	154000	210000	227000	251000	257000		
20667	326	0200038869010	39600	32400	F	90000	131000	150000	237000	256000	256000	376000
					F	474000	525000					
20668	326	0200038869010	39600	32400	F	86000	90000	109000	126000	158000	160000	209000
					F	214000	265000	277000	454000	484000	530000	565000
					F	684000	730000	794000				
20669	326	0200038869010	39600	32400	F	81000	85000	86000	97000	101000	108000	132000
					F	134000	164000	167000	170000			
20670	326	0200038869010	39600	32400	F	60000	62000	67000	81000	130000	137000	156000
					F	158000	252000	386000				
20671	326	0200038869010	39600	32400	F	79000	83000	86000	89000	97000	122000	132000
					F	137000	142000	145000	151000	169000	170000	
20672	316	0443941869010	45520	37240	F	42000	91000	119000	48000	174000	185000	56000
					F	60000	64000	40000				
20673	316	0443941869010	45520	37240	F	101000	144000	47000	59000	45000	68000	67000
					F	75000	83000	46000				
20674	316	0462641869010	49320	40350	F	263000	117000	72000	127000	208000	85000	139000
					F	98000	71000	155000				
20675	316	0462641869010	49320	40350	F	57000	85000	47000	289000	28000	42000	222000
					F	86000	28000	66000				
20676	316	0443941869010	45520	37240	F	353000	423000	709000	322000	72000	61000	262000
					F	201000	107000	371000				
20677	316	0443941869010	45520	37240	F	80000	48000	47000	86000	99000	176000	53000
					F	97000	228000	47000				
20678	316	0462641869010	49320	40350	F	64000	63000	356000	137000	112000	381000	208000
					F	61000	333000	143000				
20679	316	0462641869010	49320	40350	F	163000	243000	417000	114000	86000	190000	189000
					F	193000	174000	100000				
20680	316	0443941869010	45520	37240	F	48000	68000	58000	76000	51000	51000	93000
					F	55000	46000	58000				
20681	304	0207536065410	30000	50000	F	63000	83000					
20682	314	0207536065410	0	50000	F	27000	35000					
20683	314	0207536065410	10000	50000	F	28500	31300					
20684	314	0207536065410	10000	47500	F	31500	31700					

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
20685	314	0207536065410	10000	30000	F	255000	290000	421000		
20686	314	0207536065410	10000	27500	F	900000	1101600			
20687	314	0207536065410	20000	50000	F	24500	28000			
20688	314	0207536060410	30000	45000	F	36000	38500			
20689	314	0207536065410	30000	50000	F	26000	27800	28600		
20690	314	0207536065410	30000	45000	F	31000	21000	46500		
20691	314	0207536065410	30000	27500	F	179100	333700	289700		
					S	179100				
20692	314	0207536065410	10000	40000	F	12600	9000			
20693	314	0207536065410	10000	17500	F	223000	344000			
20694	314	0207536065410	20000	15000	F	202000	181500	164000		
20695	314	0207536065410	20000	20000	F	449000	225000			
20696	324	0106498065010	42500	42500	F	82	2603	5195		
20697	324	0106498065010	40000	40000	F	6091	9263			
20698	324	0106498065010	37500	37500	F	9651	12660			
20699	324	0106498065010	35000	35000	F	13556	15207			
20700	324	0106498065010	30000	30000	F	18000	35000			
20701	324	0106498065010	27500	27500	F	50000	54000			
20702	324	0106498065010	25000	25000	F	84000	98000			
20703	324	0106498065010	22500	22500	F	121000	177000			
20704	324	0106498065010	20000	20000	F	424000	624000	868000		
20705	324	0106498065010	41500	41500	F	36	52			
20706	324	0106498065010	35000	35000	F	848	1375			
20707	324	0106498065010	32500	32500	F	1689	1910			
20708	324	0106498065010	30000	30000	F	2245	3014			
20709	324	0106498065010	25000	25000	F	11000	12000			
20710	324	0106498065010	20000	20000	F	40000	48000			
20711	324	0106498065010	15000	15000	F	160000	217000			
20712	309	0428399065010	110000	90000	F	7000	8000			
20713	309	0428399065010	77500	63000	F	540000	1662000			
20714	309	0428399065010	99000	81000	F	4000	5000			
20715	309	0428399065010	66000	54000	F	146000	361000			
20716	309	0428399065010	44000	36000	F	1307000	11873000			
20717	309	0428399065010	99000	81000	F	1000	1100			
20718	309	0428399065010	77000	63000	F	3000	4000			
20719	309	0428399065010	44000	36000	F	31000	31100			
20720	309	0428399065010	38500	31500	F	128000	2693000			
20721	327	0301298819010	67000	67000	F	423	542	480	610	348
20722	327	0301298929010	67000	67000	F	523	637	562	701	688
20723	327	0301298819018	83000	83000	F	1241	1609	1237	1453	1204
20724	327	0301298929018	83000	83000	F	1430	1332	1339	1243	1894

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
20725	327	0301298819018	98000	98000	F	545	453	457	519	585
20726	327	0301298929018	98000	98000	F	449	747	617	695	970
20727	327	0301296819011	67000	67000	F	150	160	177	200	150
20728	327	0301298929011	67000	67000	F	250	250	300	250	282
20729	327	0302098819010	58500	58500	F	1130	1220	1308	1331	1266
20730	327	0302098819010	66500	66500	F	539	694	536	493	606
20731	327	0302098819010	74000	74000	F	320	466	390	402	411
20732	327	0302098819010	66500	66500	F	524	547	618	409	498
20733	327	0302098929010	58500	58500	F	764	855	802	833	840
20734	327	0302098929010	66500	66500	F	413	456	505	549	493
20735	327	0302098929010	74000	74000	F	319	255	261	340	301
20736	327	0302098919010	58500	58500	F	704	804	574	767	480
20737	327	0302098919010	66500	66500	F	517	311	301	411	388
20738	327	0302098919010	74000	74000	F	220	290	224	266	279
20739	327	0302098819018	85000	85000	F	1971	1646	2012	1146	1950
20740	327	0302098819018	96500	96500	F	636	650	703	798	664
20741	327	0302098819018	108000	108000	F	307	292	292	296	321
20742	327	0302098819018	96500	96500	F	573	722	485	583	476
20743	327	0302098929018	85000	85000	F	1096	1040	959	1217	554
20744	327	0302098929018	96500	96500	F	550	642	613	643	659
20745	327	0302098929018	108000	108000	F	344	344	381	315	198
20746	327	0302098919018	85000	85000	F	750	875	987	962	1051
20747	327	0302098919018	96500	96500	F	493	652	522	463	404
20748	327	0302098919018	108000	108000	F	224	211	282	209	211
20749	327	0302098819018	99500	99500	F	772	1068	616	811	703
20750	327	0302098819018	112500	112500	F	649	218	317	187	254
20751	327	0302098819018	126000	126000	F	100	109	121	186	150
20752	327	0302098819018	112500	112500	F	201	295	220	154	248
20753	327	0302098929018	99500	99500	F	855	620	1002	678	662
20754	327	0302098929018	112500	112500	F	240	350	330	312	375
20755	327	0302098929018	126000	126000	F	75	113	86	165	88
20756	327	0302098919018	99500	99500	F	415	467	412	457	511
20757	327	0302098919018	112500	112500	F	96	182	221	271	124
20758	327	0302098919018	126000	126000	F	67	119	76	76	101
20759	327	0302098819011	58500	58500	F	550	649	560	520	445
20760	327	0302098819011	66500	66500	F	234	260	252	200	263
20761	327	0302098819011	74000	74000	F	150	250	197	200	200
20762	327	0302098819011	66500	66500	F	250	350	250	200	200
20763	327	0302098929011	58500	58500	F	415	400	450	400	500
20764	327	0302098929011	66500	66500	F	240	300	300	250	250
20765	327	0302098929011	74000	74000	F	150	150	150	150	200

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)				
20766	327	0302098919011	58500	58500	F	333	435	305	432	260
20767	327	0302098919011	66500	66500	F	310	180	203	199	192
20768	327	0302098919011	74000	74000	F	166	45	179	168	192
20769	321	1402598960910	27500	22500	F	101160	78660	148500		
20770	321	1402598960910	27500	22500	F	114300	97020	61560		
20771	321	1402598960916	31900	26100	F	21420	23220	25020		
20772	321	1402598960916	35800	29200	F	18900	21780			
20773	321	1402598960916	31900	26100	F	18540	21240	26100		
20774	321	1402598960916	35800	29200	F	18900	18180			
20775	321	1402598919910	66000	54000	F	34380	27540	48780		
20776	321	1402598960911	VARIABLE AMP. LOADS		F	2278	2304	2500	2500	
20777	321	1402598960911	VARIABLE AMP. LOADS		F	6800	7200	7400	7600	
20778	321	1402598960910	VARIABLE AMP. LOADS		F	8100	8500	8500	10380	
20779	321	1402598962910	VARIABLE AMP. LOADS		F	80000	80000			
					S	80000	80000			
20780	321	1402598962910	33000	27000	F	181260	186000			
20781	321	1402598960917	VARIABLE AMP. LOADS		F	3250	3000	3250	3000	
20782	321	1402598962917	VARIABLE AMP. LOADS		F	17000	16000	17000	17000	
20783	321	1402598960914	VARIABLE AMP. LOADS		F	3400	4000	3400	3500	
20784	321	1402598962914	VARIABLE AMP. LOADS		F	6900	6900	3900	3900	
20785	321	1402598960914	32500	32500	F	16587	22598			
20786	321	1402598960914	32500	32500	F	9699	12362			
20787	321	1402598919914	65000	65000	F	8490	20480			
20788	321	1402598919914	65000	65000	F	13337	23837			
20789	321	1402598960316	34100	27900	F	10980	207360	364320		
20790	321	1402598919316	63250	51750	F	1000000	23500			
					S	1000000				
20791	321	1402598960916	34100	27900	F	11160	10800	12960		
20792	321	1402598919916	63250	51750	F	1000000	30420			
					S	1000000				
20793	321	1402598960916	34100	27900	F	1000000	14220			
					S	1000000				
20794	321	1402598919916	63250	51750	F	203400	24120	34200		
20795	321	1402598960316	34100	27900	F	18180	19980	10620		
20796	321	1402598919316	63250	51750	F	62820	51840	41580		
20797	321	1402598960916	34100	27900	F	17100	18720	16020		
20798	321	1402598919916	63250	51750	F	25200	38880	19620		
20799	321	1402598960917	VARIABLE AMP. LOADS		F	2300	2900			
20800	313	2535745865910	88000	72000	F	9000	16000			
20801	313	2535745865910	77000	63000	F	49000	29000			
20802	313	2535745865910	66000	54000	F	223000	79000			

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	STRESSES ALT.		DATA - FAILED (F) OR SUSPENDED (S)			
20803	313	2535745865910	49500	40500	F	10000000	10516000		
					S	10000000	10516000		
20804	313	2535745965910	93500	76500	F	5000	5100		
20805	313	2535745965910	77000	63000	F	16000	10000		
20806	313	2535745965910	66000	54000	F	16000	1308000		
20807	313	2535745965910	55000	45000	F	27000	52000	2114000	
20808	313	2535745965910	49500	40500	F	1289000	7959000		
20809	313	2535745865910	88000	72000	F	13000	7000		
20810	313	2535745865910	77000	63000	F	29000	21000		
20811	313	2535745865910	66000	54000	F	48000	257000		
20812	313	2535745865910	60500	49500	F	10111000	1776000		
					S	10111000			
20813	313	2535745965910	88000	72000	F	8000	10000		
20814	313	2535745965910	77000	63000	F	51000	16000		
20815	313	2535745965910	66000	54000	F	45000	30000		
20816	313	2535745965910	55000	45000	F	76000	42000		
20817	313	2543045865910	71500	58500	F	40000	40100		
20818	313	2543045865910	60500	49500	F	101000	24000		
20819	313	2543045965910	71500	58500	F	17000	14000		
20820	313	2543045965910	66000	54000	F	18000	18100		
20821	313	2543045965910	60500	49500	F	24000	26000		
20822	313	2543045965910	55000	45000	F	31000	54000		
20823	313	2543045865910	82500	67500	F	10000	11000	10000	
20824	313	2543045865910	74250	60750	F	12000	10000		
20825	313	2543045865910	63250	51750	F	147000	58000		
20826	313	2531545865910	170000	170000	F	282	367	283	
20827	313	2531545965310	170000	170000	F	147	206		
20828	313	2531545965910	170000	170000	F	331	420	202	318
20829	313	2531545965310	155000	155000	F	230	302		
20830	313	2531545965910	155000	155000	F	538	500		
20831	313	2531545965910	125000	125000	F	1342	1370		
20832	313	2531545865310	170000	170000	F	195	255		
20833	313	2531545865910	170000	170000	F	280	327	274	
20834	313	2531545965310	170000	170000	F	148	129		
20835	313	2531545965910	170000	170000	F	286	200	243	
20836	313	2531545965310	155000	155000	F	267	274		
20837	313	2531545965910	155000	155000	F	357	416		
20838	313	2531545965910	125000	125000	F	1348	4820		
20839	313	2531545865310	170000	170000	F	207	212		
20840	313	2531545865310	170000	170000	F	231	205		
20841	313	2531545865910	170000	170000	F	282	222		

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	ALT.		DATA - FAILED (F) OR SUSPENDED (S)						
20842	313	2531545865310	155000	155000	F	157	255					
20843	313	2531545865910	155000	155000	F	392	397					
20844	313	2531545865310	170000	170000	F	36	68					
20845	313	2531545865310	170000	170000	F	1	64					
20846	313	2531545865910	170000	170000	F	58	54					
20847	313	2531545865910	125000	125000	F	680	581					
20848	333	0175099019010	15000	15000	F	451700	417400					
20849	333	0175099019010	18000	18000	F	89200	180600					
20850	333	0175099019010	20000	20000	F	184000	207700					
20851	333	0175099019010	15000	15000	F	447300	1223700					
20852	333	0175099019010	20000	20000	F	124200	38500	82900				
20853	333	0175099019010	15000	15000	F	2883200	1803700					
20854	333	0175099019010	17500	17500	F	112700	74000					
20855	333	0175099019010	15250	15250	F	533700	118800					
20871	331	0131326019010	15600	12000	F	52460	58130	65980	49860	133410	171190	86560
					F	55600	71190					
20872	331	0131326019010	15600	12000	F	85000	102060	59230	62290	107500	50460	112290
					F	78860	49190					
20873	331	0131326019010	15600	12000	F	56700	96250	119550	85000	64950	163550	50820
					F	211550	128550					
20874	331	0131326019010	15600	12000	F	80240	51650	56240	70600	39630	64950	84100
					F	61880	50370					
20875	331	0131326019010	15600	12000	F	97860	93960	71960	138310	50950	119620	103450
					F	115260	86500					
20876	331	0131326019010	15600	12000	F	95550	161500	115180	237620	171380	164200	76810
					F	131800	174740					
20877	331	0131326019010	15600	12000	F	86390	95090	291910	191380	143000	81160	89180
					F	118010	174640					
20878	331	0131326019010	15600	12000	F	168190	185000	230840	244230	179510	129130	228930
					F	211230	149090					
20879	331	0131326019010	15600	12000	F	97860	255720	230580	103770	83940	573220	151410
					F	243860	80660					
20880	331	0131326019010	15600	12000	F	215199	280960	288180	98000	153360	252170	186590
					F	227360	68030					
20881	331	0131326019010	15600	12000	F	90220	123460	109070	271460	191800	203600	114090
					F	147760	65640					
20882	331	0131326019010	15600	12000	F	50520	101810	275250	184570	114910	96050	148390
					F	158350	97170					
20883	331	0131326019010	15600	12000	F	90990	340210	268070	144940	167310	105140	236110
					F	243980	105500					
20884	331	0131326019010	15600	12000	F	203880	242460	112850	131540	105140	142250	184220

STEEL FATIGUE DATA

ITEM	REF	DESCRIPTION 1234 ... 13	STRESSES MEAN	STRESSES ALT.	DATA - FAILED (F) OR SUSPENDED (S)						
					F	135150	274900				
20885	331	0131326019010	15600	12000	F	237870	107980	156470	136430	277930	142620	107290
					F	108630	119200				
20886	302	0402592865910	40000	31000	F	9600	9700				
20887	302	0402592865910	40000	21000	F	20400	23000				
20888	302	0402592865910	40000	11000	F	80300	93100				
20889	302	0402592865910	40000	6000	F	462800	392600				
20890	302	0402592865916	40000	31000	F	4800	4100				
20891	302	0402592865916	40000	21000	F	13400	15300				
20892	302	0402592865916	40000	11000	F	57100	55800				
20893	302	0402592865916	40000	6000	F	130000	183700				
20894	302	0402592965910	40000	31000	F	2200	1600				
20895	302	0402592965910	40000	21000	F	7000	7100				
20896	302	0402592965910	40000	11000	F	44600	43400				
20897	302	0402592965910	40000	6000	F	312100	392000				
20898	302	0402592965916	40000	31000	F	1100	1200				
20899	302	0402592965916	40000	21000	F	3000	3900				
20900	302	0402592965916	40000	11000	F	9600	19300				
20901	302	0402592965916	40000	6000	F	118700	81600				
20902	302	0402592865910	40000	31000	F	9300	12000				
20903	302	0402592865910	40000	21000	F	29600	36100				
20904	302	0402592865916	40000	31000	F	5700	6000				
20905	302	0402592865916	40000	21000	F	15000	11700				
20906	302	0402592865916	40000	11000	F	80600	70500				
20907	302	0402592965910	40000	31000	F	3800	4300				
20908	302	0402592965910	40000	21000	F	19700	17100				
20909	302	0402592965910	40000	11000	F	171200	177500				
20910	302	0402592965916	40000	31000	F	2500	2100				
20911	302	0402592965916	40000	21000	F	6700	6800				

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13. ABSTRACT

An investigation of the fatigue performance test scatter in titanium alloys and steels has been made with the intent of identifying their variability in terms of a distribution and its shape parameter. The two-parameter Weibull distribution was selected for matching the fatigue variability of these two materials. About 1200 groups of titanium alloy and 800 groups of steels were collected and analyzed to determine the feasibility of establishing a typical distributional Weibull shape parameter for these materials. A Weibull distribution shape parameter of 3.0 is suggested for titanium alloys and those steels with a 240-ksi strength level or less. Steels having greater than a 240-ksi strength level seem better represented by a shape parameter of 2.2. In a further study, the choice of a distribution most aptly matching fatigue variability was explored with the use of previously collected extensive aluminum alloy and the titanium alloy data. The behavior of these data was compared to that of equivalent log-normal, two-parameter, three-parameter, or a devised "symmetric" Weibull distribution. Monte-Carlo simulation was used to form empiric distributions from parent analytical populations. These distributions were then compared to the distributions of the collected fatigue test data, keeping the simulated data group sizes and number of groups the same as those for the test data. No appreciable difference between data and the selected equivalent theoretical distributions is evident for probabilities of failure in the range of 0.05 to 0.95. For a failure likelihood less than 0.05 the Weibull distribution seems more representative of the data extremes.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
a. Reliability						
b. Structure						
c. Fatigue						
d. Crack initiation						
e. Crack propagation						
f. Distribution						
g. Mean						
h. Shape parameter						
i. Scale parameter						

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